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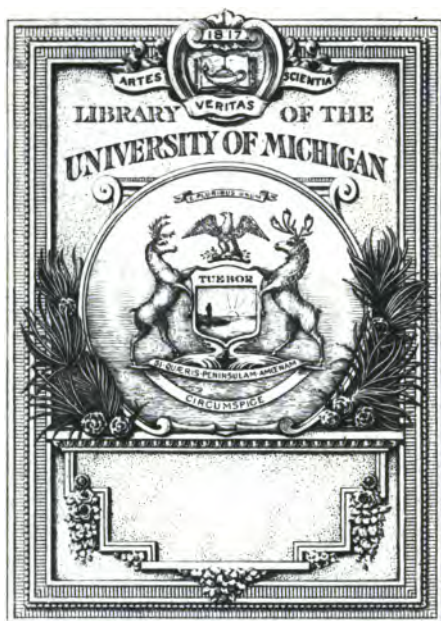
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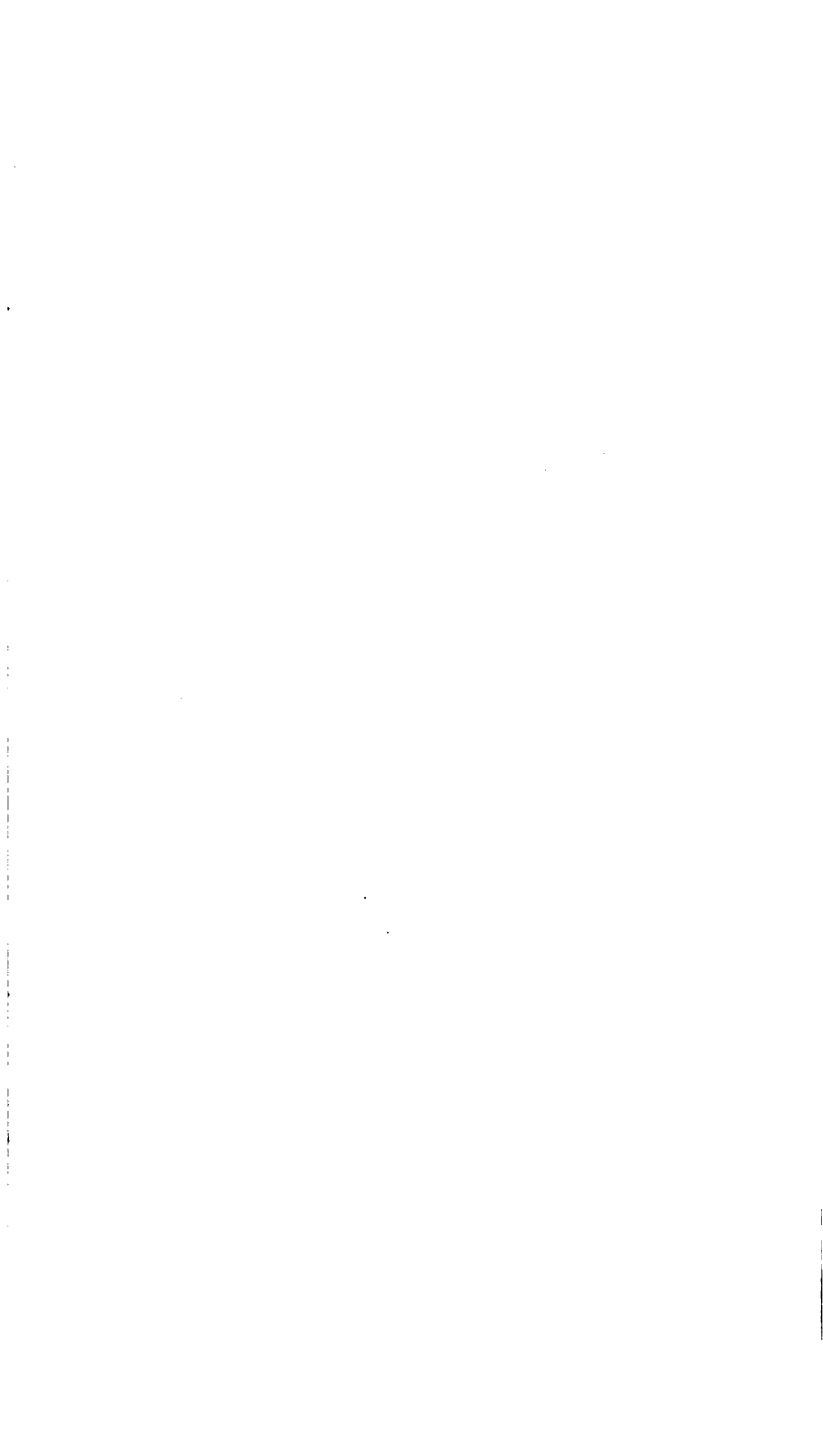


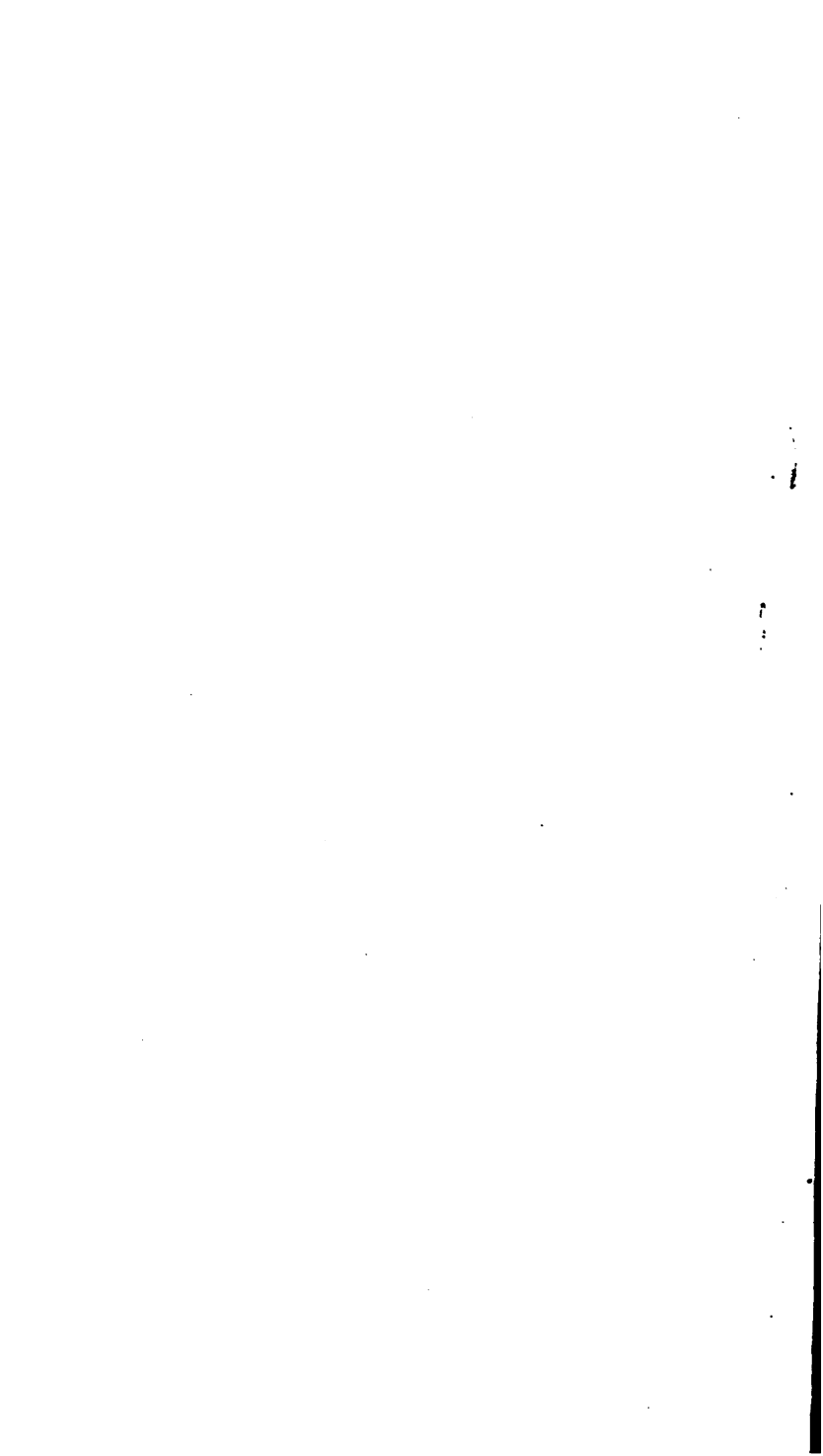
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Miscellaneæ Curiosæ :
O R,
Entertainments
FOR THE
Ingenious of Both Sexes.

For the MONTHS of *January,*
February and *March,* 1734

CONTAINING,

I. ENIGMA'S. II. PARADOXES.
III. MATHEMATICAL QUESTIONS.
Suited both to Beginners, and also to
such as have made higher Advances in
those STUDIES.

*Me vero primum dulces ante omnia Muses,
Quarum sacra fero ingenti percussus Amore,
Accipiant : Cœlique Vias & Sydera monstrant,
Defectus Solis varios, Lunæque Labores :
Unde Tremor Terris : quâ Vi maria alta tumescant
Obiicibus ruptis, rursusque in se ipsa residant :
Quid tantum Oceano properent se tingere Soles
Hyberni, vel quæ tardis mora Noctibus obset.*

VIRGIL. *Georgic.*



WORK: Printed by THO. GENT, in
Coffee-Yard, MDCCXXXIV.



THE

3-7-40 mfk

The Mathematick Arts need no Recommendation, they carry their own Reward with 'em, by leading us to Truth by the nearest Way, and with the greatest certainty: The Antients held them in so much esteem, that their Kings were not only Encouragers of them, but Students in them, they accounting that Person unfit to govern the World who knew not what the World was: They give us more just and adequate Notions of the Universe, and of the Situation of the Parts and extent of our own System; " and do most " powerfully demonstrate to us the Existence and Attributes

A 2

of

“ of some Almighty designer ; to prove this to any Person,
 “ one need only to bid him consider the Sun with that in-
 “ supportable Glory and Lustre that surrounds it : To de-
 “ monstrate the vast Distance, Magnitude, and Heat of it :
 “ To represent to him the Chorus of Planets moving perio-
 “ dically by uniform Laws, in their several Orbits about
 “ it ; affording a regular Variety of Aspects ; guarded some
 “ of them by secondary Planets, and as it were emulating
 “ the State of the Sun ; and probably all possess by proper
 “ Inhabitants, to remind him of those surprizing Visits the
 “ Comets makes us ; the large Trains, or uncommon Splen-
 “ dor which attends them ; the far Cuntry they come from ;
 “ and the Curiosity and Horror they excite, not only among
 “ us, but in the Inhabitants of other Planets, who also may
 “ be up to see the Entry and Progress of these Ministers of
 “ Fate : To direct his Eye and Contemplation through
 “ those azure Fields, and vast Regions above him, up to the
 “ fixed Stars, that radiant numberless Host of Heaven ;
 “ and to make him understand how unlikely a Thing it is,
 “ that they should be placed there only to adorn and be-
 “ spangle a Canopy over our Heads, and much less to supply
 “ the Places of so many Glow-Worms, by affording a feeble
 “ Light to our Earth, or even to all our Fellow Planets :
 “ To convince him, that they are so many other Suns, with
 “ their several Regions and Sets of Planets about them :
 “ To shew him by the Help of Glasses, still more and more
 “ of these fix’d lights, and to beget in him an Apprehension
 “ of their unaccountable Numbers, and of the immense
 “ Spaces, that lye retired beyond our utmost Reach, and
 “ even Imagination : I say, one need but do this, and explain
 “ to him such Things as are now known almost to every
 “ Body, and by it to shew that if the World be not infinite,
 “ it is infinito Similis ; and therefore sure a magnificent
 “ Structure, and the Work of an infinite Architect

Such are the Advantages we receive from the Science of
 Mathematicks, and as long as the Investigation of Truth con-
 tinues to be pleasant (which will be always to intelligent and
 rational Minds) so long will also the above-named Study be :
 I shall adjoin to this, the excellent Dr. Cotes’s Preface to the
 2d Edition of Sir Isaac Newton’s Principia, as an Introduc-
 tion to the following Work, in which he shews the Prehemi-
 nence of experimental Philosophy above the Hypothetical.

February the 26th,

1733-4 &c.

Miscellaneous



Miscellanæ Curiosæ, &c.



Extracted from Dr. R. COTES.



THOSE who have treated of Natural Philosophy may be nearly reduced to three Classes. Of these, some have attributed, to the several Species of Things, Specific and Occult Qualities ; on which, in a Manner unknown, they make the Operations of the several Bodies to depend. The Sum of the Doctrine of the Schools, derived from *ARISTOTLE* and the *Peripatetics*, is herein contained. They affirm, That the several Effects of Bodies arise from the particular Natures of those Bodies : But whence it is that Bodies derive those Natures, they don't tell us ; and therefore, they tell us nothing. And being entirely employed in giving Names to Things, and not in searching into Things themselves, we may say they have invented a philosophical Way of Speaking, but not that they have made known to us true Philosophy.

OTHERS therefore, laying aside that useless Heap of Words, thought to employ their Pains to better Purpose. These supposed all Matter homogeneous ; and that the Variety of Forms, which is seen in Bodies, arises from some very plain and simple Affections of the component Particles : And by going on from simple Things, to those which are more compounded, they certainly proceed right ; if they attribute no other Properties to those pri-
mary

mary Affections of the Particles, than Nature has done. But when they take a Liberty of imagining at Pleasure unknown Figures and Magnitudes, and uncertain Situations and Motions of the Parts; and moreover of supposing occult Fluids, freely pervading the Pores of Bodies, endued with an all-performing Subtilty, and agitated with occult Motions, they now run out into Dreams and Chimera's, and neglect the true Constitution of Things; which certainly is not to be expected from fallacious Conjectures, when we can scarce reach it by the most certain Observations. Those who fetch from Hypotheses the Foundations on which they build their Speculations, may form indeed an ingenious Romance, but a Romance it will still be.

THERE is left then the third Class, which profess Experimental Philosophy. These indeed derive the Causes of all Things from the most simple Principles possible; but then they assume nothing as a Principle, that is not proved by *Phænomena*. They frame no Hypotheses, nor receive them into Philosophy, otherwise than as Questions whose Truth may be disputed. They proceed therefore in a two-fold Method, *Synthetical* and *Analytical*. From some select *Phænomena* they deduce by *Analysis* the Forces of Nature, and the more simple Laws of Forces; and from thence by *Synthesis* shew the Constitution of the rest. This is that incomparably best Way of Philosophizing, which Sir *Isaac Newton* most justly embraced before the rest; and thought alone worthy to be cultivated and adorn'd by his excellent Labours. Of this he has given us a most illustrious Example by the Explication of the System of the World, most happily deduced from the Theory of Gravity. That the Virtue of Gravity was found in all Bodies, others suspected, or imagined before him; but he was the only and the first Philosopher that could demonstrate it from Appearances, and make it a Solid Foundation to the most noble Speculations.

I know indeed, that some Persons, and those of great Name, prepossess'd with certain Prejudices, are unwilling to assent to this new Principle, and are ready to prefer uncertain Notions to certain. It is not my Intention to detract from the Reputation of these eminent Men: I shall only lay before the Reader such Considerations as will

will enable him to pass an equitable Sentence in this Dispute.

THEREFORE that we may begin our reasoning from what is most simple and nearest to us : Let us consider a little what is the Nature of Gravity with us on Earth, that we may proceed the more safely when we come to consider it in the Heavenly Bodies. that lie at so vast a Distance from us. It is now agreed by all Philosophers, that all circumterrestrial Bodies gravitate towards the Earth ; that no Bodies really light, are to be found, is now confirmed by manifold Experience. That which is Relative Levity, is not true Levity, but apparent only ; and arises from the preponderating Gravity of the contiguous Bodies.

MOREOVER, as all Bodies gravitate towards the Earth, so does the Earth again towards Bodies. That the Action of Gravity is mutual, and equal on both Sides, is thus proved. Let the Mass of the Earth be distinguished into any two Parts whatever either equal, or any how unequal : Now if the Weights of the Parts towards each other, were not mutually equal, the lesser Weight would give Way to the greater, and the two Parts joined together, would move on *ad infinitum* in a right Line, towards that Part to which the greater Weight tends ; altogether against Experience. Therefore we must say, that the Weights of the Parts are constituted in *equilibrio* ; that is, that the Action of Gravity is mutual and equal on both Sides.

THE Weights of Bodies at equal Distances from the Centre of the Earth, are as the Quantities of Matter in the Bodies. This is collected, from the equal Acceleration of all Bodies, that fall from a State of Rest, by the Force of their Weights ; for the Forces, by which unequal Bodies, are equally accelerated, must be proportional to the Quantities of the Matter to be moved. Now that all Bodies are in falling equally accelerated appears from hence ; that when the Resistance of the Air is taken away, as it is under an exhausted Receiver, Bodies falling describe equal Spaces, in equal Times ; and this is yet more accurately proved by the Experiments of *Pendulums*.

THE attractive Forces of Bodies at equal Distances, are as the Quantity of Matter in the Bodies. For since
Bodies

Bodies gravitate towards the Earth, and the Earth again towards Bodies, with equal Moments ; the Weight of the Earth towards every Body or the Force with which the Body attracts the Earth, will be equal to the Weight of the same Body towards the Earth. But this Weight was shewn to be, as the Quantity of Matter in the Body ; and therefore the Force with which every Body attracts the Earth, or the absolute Force of the Body, will be as the same Quantity of Matter.

THEREFORE, the attractive Force of the entire Bodies, arises from, and is compounded of the attractive Forces of the Parts ; because as was just shewn : If the Bulk of the Matter be augmented, or diminished, its Virtue is proportionably augmented, or diminished. We must therefore conclude, that the Action of the Earth is compounded of the united Actions of its Parts ; and therefore, that all terrestrial Bodies must attract each other mutually, with absolute Forces that are as the Matter attracting. This is the Nature of Gravity upon Earth ; let us now see what it is in the Heavens.

THAT every Body perseveres in its State, either of Rest, or of moving uniformly in a right Line, (unless so far as it is compell'd to change that State by Forces impress'd) is a Law of Nature universally received by all Philosophers. But from thence it follows that Bodies which move in Curve Lines, and are therefore continually going off from the right Lines that are Tangents to their Orbits, are by some continued Force retained in those curvilinear Paths. Since then the Planets move in curvilinear Orbits, there must be some Force operating, by whose repeated Actions they are perpetually made to deflect from the Tangents.

Now it is collected by mathematical Reasoning, and evidently demonstrated, that all Bodies that move in any Curve Line described in a Plane ; and which, by a Radius drawn to any Point, whether quiescent, or any how mov'd, describe Areas about that Point, proportional to the Times, are urged by Forces directed towards that Point. This must therefore be granted. Since then all Astronomers agree, that the Primary Planets describe about the Sun, and the Secondary about the Primary, Areas proportional to the Times ; it follows that the Forces

by

by which they are perpetually turned aside from the rectilinear Tangents, and made to revolve in curvilinear Orbits, are directed towards the Bodies that are situated in the Centre of the Orbits. This Force may therefore not improperly be called Centripetal in respect of the revolving Body, and in Respect of the Central Body attractive ; whatever Cause it may be imagined to arise from.

BUT besides, these Things must be also granted, as being Mathematically demonstrated : If several Bodies revolve with an equable Motion in concentric Circles, and the Squares of the Periodic Times are as the Cubes of the Distances from the common Centre ; the Centripetal Forces will be reciprocally as the Squares of the Distances ; or, if Bodies revolve in Orbits that are very near to Circles, and the Apfides of the Orbits rest ; the Centripetal Forces of the revolving Bodies will be reciprocally as the Squares of the Distances. That both these Cases hold in all the Planets, all Astronomers consent. Therefore the Centripetal Forces of all the Planets are reciprocally as the Squares of the Distances from the Centres of their Orbits. If any should object, that the Apfides of the Planets, and especially of the Moon, are not perfectly at rest, but are carried with a slow kind of Motion in *Consequentia* : One may give this Answer, That though we should grant this very slow Motion to arise from hence ; that the Proportion of the Centripetal Force is a little different from the Duplicate ; yet, that we are able to compute Mathematically the Quantity of that Aberration, and find it perfectly insensible. For the Ratio of the Lunar Centripetal Force itself, which must be the most irregular of them all, will be indeed a little greater than the Duplicate, but will be sixty Times nearer to that, than it is to the Triplicate. But we may give a truer Answer, by saying that this Progression of the Apfides arises not from an Aberration from the Duplicate proportion, but from a quite different Cause, as is most admirably shewn in Sir Isaac Newton's *Principia*. It is certain then, that the Centripetal Forces with which the Primary Planets tend to the Sun, and the Secondary to their Primary, are accurately, as the Squares of the Distances reciprocally.

FROM what has been already said, it is plain that the Planets are retained in their Orbits, by some Force perpetually acting upon them ; it is plain, that that Force is always directed towards the Centres of their Orbits ; it is plain that its efficacy is augmented with the nearness to the Centre, and diminished with the same ; and that it is augmented in the very Proportion with which the Square of the Distance is diminished ; and diminished in the same Proportion with which the Square of the Distance is augmented. Let us now see whether, by making a Comparison between the Centripetal Forces of the Planets, and the Force of Gravity, we may not by Chance find them to be of the same Kind. Now they will be of the same Kind, if we find on both Sides the same Laws, and the same Affections. Let us then first consider the Centripetal Force of the Moon, which is nearest to us.

THE rectilinear Spaces, which Bodies let fall from Rest, describe in a given Time at the very beginning of the Motion, when the Bodies are urged by any Forces whatsoever, are proportional to the Forces : This appears from Mathematical reasoning. Therefore the Centripetal Force of the Moon revolving in its Orbit, is to the Force of Gravity at the Surface of the Earth, as the Space (which in a very small Particle of Time, the Moon deprived of all its circular Force, and descending by its Centripetal Force towards the Earth) would describe, is to the Space which a heavy Body would describe, when falling by the Force of its Gravity near to the Earth, in the same given Particle of Time. The first of these Spaces is equal to the versed Sign of the Arc, described by the Moon in the same Time, because that versed Sign measures the Translation of the Moon from the Tangent, produced by the Centripetal Force ; and therefore may be computed, if the Periodic Time of the Moon, and its Distance from the Centre of the Earth are given. The last Space is found by Experiments of *Pendulums*, as Mr. *Huygens* has shewn. Therefore by making a Calculation, we shall find, that the first Space is to the latter, or the Centripetal Force of the Moon revolving in its Orbit, will be to the Force of Gravity at the Superficies of the Earth as the Square of the Semi-diameter

diameter of the Earth, to the Square of the Semidiameter of the Orbit.

BUT, by what was shewn before, the very same *Ratio* holds between the Centripetal Force of the Moon revolving in its Orbit, and the Centripetal Force of the Moon near the Surface of the Earth: Therefore the Centripetal Force near the Surface of the Earth, is equal to the Force of Gravity. Therefore these are not two different Forces, but one and the same; for if they were different, these Forces united would cause Bodies to descend to the Earth with twice the Velocity they would fall with by the Force of Gravity alone. Therefore it is plain, that the Centripetal Force, by which the Moon is perpetually, either impelled or attracted out of the Tangent, and retained in its Orbit, is the very Force of terrestrial Gravity reaching up to the Moon: And, it is very reasonable to believe, that Virtue should extend itself to vast Distances, since upon the Tops of the highest Mountains we find no sensible Diminution of it.

THEREFORE the Moon gravitates towards the Earth; but, on the other hand, the Earth, by a mutual Action, gravitates towards the Moon: Which is also abundantly confirmed by the *Newtonian* Philosophy, where the Tides in the Sea, and the Precession of the Equinoxes are treated of; which arise from the Action both of the Moon and of the Sun upon the Earth. Hence, lastly, we discover by what Law the Force of Gravity decreases at great Distances from the Earth. For since Gravity is no ways different from the Moon's Centripetal Force, and this is reciprocally proportional to the Square of the Distance; it follows, that it is in that very *Ratio* that the Force of Gravity decreases.

LET us now go on to the rest of the Planets. Because the Revolutions of the primary Planets, about the SUN, and of the Secondary about *Jupiter* and *Saturn*, are *Phænomena* of the same Kind with the Revolution of the MOON about the Earth; and because it has been moreover demonstrated, that the Centripetal Forces of the primary Planets are directed towards the Centre of the SUN, and those of the Secondary towards the Centres of *Jupiter* and *Saturn*, in the same Manner as the Centripetal Force of the Moon is directed towards the

Centre of the Earth ; and since besides, all these Forces are reciprocally as the Squares of the Distances from the Centres, in the same Manner as the Centripetal Force of the Moon is as the Square of the Distance from the Centre of the Earth ; we must of Course conclude, that the Nature of all is the same. Therefore as the Moon gravitates towards the Earth, and the Earth again towards the Moon ; so also the Secondary Planets will gravitate towards their Primary, and the Primary Planets again towards their Secondary ; and so all the Primary towards the SUN ; and the Sun again towards them.

THEREFORE the Sun gravitates towards all the Planets, and all the Planets towards the Sun. For the Secondary Planets, while they accompany the Primary, revolve the mean while with the Primary about the Sun. Therefore, by the same Argument, the Planets of both Kinds gravitate towards the Sun, and the Sun towards them. That the Secondary Planets gravitate towards the Sun, is moreover abundantly clear from the Inequalities of the Moon ; a most accurate Theory of which, laid open with a most admirable Sagacity, we find explained in the Third Book of Sir ISAAC NEWTON's *Principia*.

THAT the attractive Virtue of the SUN is propagated on all Sides to prodigious Distances, and is diffused to every Part of the wide Space that surrounds it, is most evidently shewn by the Motion of the Comets ; which, coming from Places immensely distant from the Sun, approach very near to it ; and sometimes so near, that in their *Perihelia* they almost touch its Body. The Theory of these Bodies was altogether unknown to Astronomers, till in our own Times the excellent NEWTON most happily discovered it, and demonstrated the Truth of it by most certain Observations. So that it is now apparent, that the Comets move in Conic-Sections, having their *Foci* in the Sun's Centre ; and, by *Radii* drawn to the Sun, describe *Areas* proportionable to the Times. But from these *Phænomena* it is manifest, and mathematically demonstrated, that these Forces, by which the Comets are retained in their Orbits, respect the Sun, and are reciprocally proportional to the Squares of the Distances from its Centre. Therefore the Comets gravitate towards the Sun ;

Sun ; and therefore the attractive Force of the Sun not only acts on the Bodies of the Planets, placed at given Distances, and very nearly in the same Plane, but reaches also to the Comets in the most different Parts of the Heavens, and at the most different Distances. This therefore is the Nature of gravitating Bodies, to propagate their Force at all Distances, to all other gravitating Bodies. But from thence it follows, that all the Planets and Comets attract each other mutually, and gravitate mutually towards each other ; which is also confirmed by the Perturbation of *Jupiter* and *Saturn*, observed by Astronomers, which is caused by the mutual Actions of these two Planets upon each other ; as also from that very slow Motion of the Apfides, above taken Notice of, and which arises from a like Cause.

WE have now proceeded so far as to shew that it must be acknowledged, that the Sun, and the Earth, and all the Heavenly Bodies attending the Sun, attract each other mutually. Therefore all the least Particles of Matter in every one, must have their several attractive Forces, whose effect is, as their Quantity of Matter ; as was shewn above of the terrestrial Particles. At different Distances, these Forces will be also in the Duplicate Ratio of the Distances reciprocally ; for it is Mathematically demonstrated, that Particles attracting according to this Law, will compose Globes attracting according to the same Law.

THE foregoing Conclusions are grounded on this Axiom which is received by all Philosophers ; namely that effects of the same kind, that is, whose known Properties are the same, take their rise from the same Causes, and have the same unknown Properties also. For who doubts, if Gravity be the Cause of the Descent of a Stone in *Europe*, but that it is also the Cause of the same Descent in *America*? If there is a mutual Gravitation between a Stone and the Earth in *Europe*, who will deny the same to be mutual in *America*? If in *Europe*, the attractive Force of a Stone and the Earth are compounded of the attractive Forces of the Parts ; who will deny the like Composition in *America*? If in *Europe*, the Attraction of the Earth be propagated to all kinds of Bodies, and to all Distances ; why may it not as well be propagated in like Manner in *America*? All Philosophy is founded on this Rule ; for if that be taken away, we can affirm nothing of Universals. The Constitution

stitution of particular Things is known by Observations and Experiments ; and when that is done, it is by this Rule that we judge of the Nature of such Things in general.

SINCE then all Bodies, whether upon Earth, or in the Heavens, are heavy, so far as we can make any Experiments or Observations concerning them ; we must certainly allow, that Gravity is found in all Bodies universally. And in like Manner, as we ought not to suppose that any Bodies can be otherwise than extended, moveable, or impenetrable ; so we ought not to conceive, that any Bodies can be otherwise than heavy. The Extension, Mobility, and Impenetrability of Bodies, become known to us, only by Experiments ; and in the very same Manner, their Gravity becomes known to us. All Bodies we can make any Observations upon, are extended, moveable, and impenetrable ; and thence we conclude all Bodies, and those we have no Observations concerning, to be extended, and moveable, and impenetrable. So all Bodies we can make Observations on, we find to be heavy ; and thence we conclude all Bodies, and those we have no Observations of, to be heavy also. If any one should say, that the Bodies of the fixed Stars are not heavy, because their Gravity is not yet observed ; they may say, for the same Reason, that they are neither extended, nor moveable, nor impenetrable, because these Affections of the fixed Stars are not yet observed. In short, either Gravity must have a Place among the Primary Qualities of all Bodies, or Extension, Mobility, and Impenetrability must not. And if the Nature of Things is not rightly explained by the Gravity of Bodies, it will not be rightly explained by their Extension, Mobility, and Impenetrability.

SOME, I know, disapprove this Conclusion, and mutter something about occult Qualities. They continually are cavilling with us, that Gravity is an occult Property ; and occult Causes are to be quite banished from Philosophy. But to this the Answer is easy ; that those are indeed occult Causes, whose Existence is occult ; and imagined, but not proved ; but not those whose real Existence is clearly demonstrated by Observations. Therefore Gravity can by no Means be called an occult Cause of the Cælestial Motions ; because it is plain, from the *Phænomena*, that such a Virtue does really exist. Those rather have Recourse to occult Causes ; who set imagin-
ry

ry Vortices of a Matter entirely fictitious, and imperceptible by our Senses, to direct those Motions.

BUT shall Gravity be therefore call'd an occult Cause, and thrown out of Philosophy, because the Cause of Gravity is occult, and not yet discovered? Those, who affirm this, should be careful not to fall into an Absurdity that may overturn the Foundations of all Philosophy. For Causes use to proceed in a continued Chain from those that are more compounded to those that are more simple; when we are arrived at the most simple Cause, we can go no farther. Therefore no mechanical Account, or Explanation of the most simple Cause, is to be expected, or given; for if it could be given, the Cause were not the most simple. These most simple Causes will you then call occult, and reject them? Then you must reject those that immediately depend upon them, and consequently those which depend upon these last, till Philosophy is quite cleared and disencumbered of all Causes.

SOME there are, who say that Gravity is præternatural, and call it a perpetual Miracle. Therefore they would have it rejected, because præternatural Causes have no Place in Physics. It is hardly worth while to spend Time in answering this ridiculous Objection, which overturns all Philosophy. For either they will deny Gravity to be in Bodies; which cannot be said: Or else, they will therefore call it præternatural, because it is not produced by the other Affections of Bodies, and therefore not by mechanical Causes. But certainly there are primary Affections of Bodies; and these, because they are primary, have no Dependence on the others. Let them consider whether all these are not in like manner præternatural, and in like manner to be rejected; and then what kind of Philosophy we are like to have.

SOME there are who dislike this celestial Physics, because it contradicts the Opinion of *Des-Cartes*, and seems hardly to be reconcil'd with them. Let these enjoy their own Opinion; but let them act fairly; and not deny the same Liberty to us, which they demand for themselves. Since then the *Newtonian* Philosophy appears true to us, let us have the Liberty to embrace and retain it, and to follow Causes proved by *Phænomena*, rather than Causes only imagined, and not yet proved. The Business of true

true Philosophy, is to derive the Natures of Things from Causes truly existent; and to enquire after those Laws on which the Great Creator actually chose, to found this most beautiful Frame of the World, not those on which he might have done the same, had he so pleased. It is reasonable enough to suppose, that from several Causes, somewhat differing from each other, the same effect may arise; but the true Cause will be that, from which it truly and actually does arise; the others have no Place in true Philosophy. The same Motion of the Hour-hand in a Clock, may be occasion'd either by a Weight hung, or a Spring shut up within. But if a certain Clock should be really moved with a Weight; we should laugh at a Man that would suppose it moved by a Spring, and from that Principle, suddenly taken up, without farther Examination, should go about to explain the Motion of the Index; for certainly the Way he ought to have taken, should have been actually to look into the inward Parts of the Machine, that he might find the true Principle of the proposed Motion.

THE like Judgment ought to be made of those Philosophers, who will have the Heavens to be filled with a most subtle Matter, which is perpetually carried round in Vortices. For if they could explain the *Phænomena* ever so accurately by their *Hypotheses*, we could not yet say, that they have discovered true Philosophy, and the true Causes of the Celestial Motions, unless they could either demonstrate that those Causes do actually exist, or at least, that no others do exist. Therefore if it be made clear, that the Attraction of all Bodies is a Property actually existing in *rerum natura*; and if it be also shewn how the Motions of the Celestial Bodies may be solved by that Property; it would be very impertinent for any one to object, that these Motions ought to be accounted for by Vortices; even though we should never so much allow such an Explication of those Motions to be possible. But we allow no such Thing, for the *Phænomena* can by no means be accounted for by Vortices; as Sir Isaac Newton, has abundantly proved from the clearest Reasons. So that Men must be strangely fond of Chimeras, who can spend their Time so idly, as in patching up a ridiculous Figment, and setting it off with new Comments of their own.

[The Remainder of this in our next.]

Ænigma's



Of an ENIGMA.

ÆNIGMAS have been of very ancient standing, and the proposing of them, a Custom as old as the Times of *SAMPSON*, who, upon the Day of his Nuptials, gave one to the young Men his Companions, to find out. It was usual also among Princes, to send them to one another, with the Offer of a Reward to him who discovered it, or to be mulcted if he could not: An *Enigma* is an ingenious obscuring of the plainest Things; which, when discover'd, strikes the Soul with Surprise, while we pleasingly wonder to see how it was possible to lay as it were a Veil before the Sun. A perfect and compleat *Enigma* pleases more when the Thing it means is known, than it did before; and is read again as a Description thereof. In the Composition of an *Enigma*, we may lawfully make use of *Tropes* and *Metaphors*, the better to conceal the Subject; but we ought not to put in any Thing paradoxical. As a Master Piece of this Kind, I shall insert the two following ones from the *Gentleman's Magazine*, and leave the Explication of them to the ingenious Reader.



ENIGMA the First.

THINK not, fair LADIES, I'm a Cheat,
 Tho' I have never seen as yet
 A HAND I could not counterfeit.
 And though to Brutes my Birth I owe,
 And so my Pedigree's but low,

By Education's friendly Aid,
 See ! what Improvement may be made.
 A R T took me from my Mother's Side,
 And did a kinder NURSE provide :
 Whose Care so far prevail'd, that soon
 I found my Native roughness gone.
 And from the Rule which Nature takes,
 In the more lovely Works she makes,
 (As when her WISDOM strives to grace
 With Eyes and Lips the human Face,
 In double Births her Work is seen,
 And each to other proves a Twin :)
 'Tis thus I in the WORLD appear,
 No sooner live but am a PAIR.
 BUT such my PRIDE, Oh ! shame to tell !
 I still endeavour to conceal
 Those Beings who gave me mine ; I mean
 My Second Being, --- but in vain :
 We're so alike, that who they are
 My every Feature does declare.
 By them I was train'd up to Arms,
 And made the Guard of Female Charms :
 And tho' I seem of gentle Mien,
 At Combates I have often been.
 But tho' I seem to threaten WAR ;
 To shew, how much I PEACE prefer,
 The dearest Friends have found in me,
 When they would Friendships LAWS decree,
 A well known PROVERB to declare,
 How very intimate they are.
 By th' YOUTH I'm claim'd for ravish'd Blissés,
 And made the FEE of stolen Kisses :
 When with a tender Tread, for fear
 His steps should wake the sleeping FAIR,
 He prints upon her melting Lip,
 The happy Forfeiture of Sleep.
 I've such obliging WAYS about me,
 There's scarce a Visit made without me :
 And I am dress'd where-e'er I go,
 To sympathize with Joy, or Woe.
 When I at FUNERALS appear,
 My Sable Robes I always wear :

And

And have a Suit of White beside,
Whenever I attend the BRIDE.

I'm seldom known, I must confess,
To boast of Riches, or of Dress :
It is my chiefest Care to hide
The radiant DIAMOND's sparkling PRIDE ;
To keep the EMERALD's lovely GREEN,
And the gay RUBY's Blush unseen ;
And all that I affect of STATE,
Is only to be plain and neat.

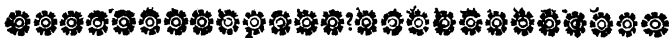
LADIES, who have a HAND at guessing,
Know, it is you I am addressing :
And by this Time, the MUSE depends
You have me at your FINGERS Ends.



ENIGMA the Second.

THOU Tyrant whom I will not name,
Whom Heaven and Hell alike disclaim ;
Abhor'd and shunn'd for wholesome Ends
By Angels, Jesuits, Brutes and Fiends ;
What Terms to curse thee shall I find,
Thou Plague peculiar to Mankind ?
Oh ! may my Verse excell in Spite
The wildest, wittiest Imps of Night !
Then lend me for a while your Rage,
Ye Maidens old, and Matrons Sage,
So may my vein Satyrick seem
As vile and hateful as my Theme.
Eternal Poe, to soft Desires,
Inflamer of forbidden Fires ;
Thou Bane of Freedom, Ease and Mirth,
Thou Pre-damnation upon Earth ;
Which makes the tender Sex endure
Repeated Deaths, without a Cure ;
Thou Serpent with a harmless Face,
Thou lawful Scourge of Human Race ;
Thou Scorpion whom the Angels fly,
Monster, whom Birds and Beasts defy ;
Whom subtle *Romish* Priests eschew,
And Satan (let him have his Due)

Was never so confirm'd a Dunce,
 To risque Perdition more than once;
 That Wretch (if such a Wretch there be)
 Who hopes for Happiness in thee,
 With vain Pursuit, may search as well
 For Truth in Whores, or Ease in Hell.



ENIGMA the Third by I. H. M.

IN England first I did appear,
 When great NASSAU the Sceptre sway'd,
 Whose generous Zeal, and prudent Care
 Our Liberties securer made:
 The publick News soon spread my Fame,
 And my intended Use made known;
 So I the chief Discourse became
 In every noted Trading Town:
 All Parties laid their Heats aside,
 Whilst with Surprise on me they gaz'd,
 And each to gain my Favour try'd
 With flattering Expectations rais'd.
 But I to Parties ne'er bigotted,
 Promiscuously my Bounty shar'd,
 Sometimes to Whigs my Smiles allotted,
 Sometimes for Tories I declar'd:
 Yet as the best and wisest Prince,
 Who with impartial Justice rules,
 Cannot secure his Innocence
 From Slanders of malicious Fools:
 So Some, whose Hopes I disappointed,
 Against me basely did exclaim.
 Thus I, some certain Marks have hinted,
 Whereby perhaps you'll guess my Name.



ENIGMA the Fourth by I. H. M.

UNCertain it is in what Part of the Earth,
 Likewise at what Time I received my Birth
 For,

For who was my Father has long been disputed,
And perhaps to the End of the World will be doubted.
I have several Sisters whose Names I conceal,
Yet something concerning them I shall reveal;
By Men of good Sense they are highly respected,
Tho' they are oft faulty, and should be corrected.

I AM far more useful in Sickness than Health,
And tho' I can't boast of my Substance or Wealth,
I have always appear'd in great Splendour and State,
Yet thereby no Envy did ever create.
In the various Sects that Religion profess,
I am a chief Party concern'd, I confess;
And, on solemn Festivals duly attend,
But in true Devotion one Moment ne'er spend.
In Affairs of the State I am always at hand,
For a Place in the Parliament House I command:
And my Loyalty never has yet been suspected,
Tho' in some Acts of Treason I have been detected.
But least I should leave you too much in the dark,
Search among the fair Sex, and you'll chance hit the Mark.
Observe when young Ladies in publick appear,
And it's twenty to one that you may find me there.



ENIGMA the Fifth, by J. H. M.

TO Water, Earth, and Fiery Arts,
We owe our first constituent Parts;
And in that Form we now retain,
May several Scores of Years remain:
Like Centinels we keep our Place,
And Winter's coldest Blasts can face;
But thereby suffer no great Harm,
Because within we are kept warm:
Our Business filthy is, and black,
Yet we Employment seldom lack;
Our Breath so noisome is, and strong,
No Mortal can endure it long.
In Villages we may be found,
But in great Cities most abound;
In Palaces, and noble Seats,
Are valu'd for our useful Feats.

A grievous chronical Disease,
 Doth on some of our Species seize,
 Which oft for Service them unfits,
 And seldom of a Cure admits.
 Sometimes, o'ercharg'd with burning Matter,
 Like *Ætna*, dreadful Flames we scatter,
 And thereby cause a strange Alarm,
 But without much succeeding Harm.



PARADOXES to be Answer'd.

A PARADOX is a kind of obscure *Enigma*. The Design of which is to puzzle the Mind by seeming Contradictions ; and therefore in the Composition we may make use of Quibbles to divert the Readers Attention, which is not to be allowed in an *Enigma*.



PARADOX the First.

ONE Evening, as I walk'd to take the Air,
 I chanc'd to overtake two Ladies fair ;
 Each by the Hand a lovely Boy did lead,
 To whom in courteous Manner thus I said :
 Ladies ! so far oblige me as to shew
 How near akin these Boys are unto you ?
 They, smiling, quickly made this dark Reply,
 Sons to our Sons they are, we can't deny :
 Though it seem strange, they are our Husbands Brothers,
 And likewise each is Uncle to the other :
 They both begot, and born in Wedlock were,
 And we their Mothers and Grandmothers are.
 Now try if you this Mystery can declare.



PARADOX the Second and Third.

Dic mihi, quâ Regione ascendunt Flumina Montes ;
 Dic quoque, quæ Matrem Filia mira parit.

I will now give you an accurate Table of *Refraction*, which is of such Consequence, that, without the Knowledge of it, we cannot be sure of the true Place of any Celestial Body: The Medium of Air, which surrounds our Earth, causing such Objects as are really under our Horizon to become visible, the Quantity, of this *Refraction* was never brought to any Kind of Rule, till *Tycho Brahe's* Time; but no accurate Table thereof was composed, till Sir *Isaac Newton* undertook to make one: A Ray of Light, as it approaches the Earth describing one of the most perplexed and intricate Curves that can well be imagined; and is very near the Common Cycloid, the Eye being the Vertex of the same.

App. d.	Alt.	Ref.	Corr.	App. d.	Alt.	Ref.	Corr.
00	00	33	45	14	00	3	31
00	15	30	24	15	00	3	17
00	30	27	35	16	00	3	4
00	45	25	11	17	00	2	53
1	00	23	7	18	00	2	43
1	15	21	20	19	00	2	34
1	30	19	46	20	00	2	26
1	45	18	22	21	00	2	18
2	00	17	8	22	00	2	11
2	30	15	2	23	00	2	5
3	00	13	20	24	00	1	59
3	30	11	57	25	00	1	54
4	00	10	48	26	00	1	49
4	30	9	50	27	00	1	44
5	00	9	2	28	00	1	40
5	20	8	21	29	00	1	36
6	00	7	45	30	00	1	32
6	30	7	14	31	00	1	28
7	00	6	47	32	00	1	25
7	30	6	22	33	00	1	22
8	00	6	00	34	00	1	19
8	30	5	40	35	00	1	16
9	00	5	22	36	00	1	13
9	30	5	6	37	00	1	11
10	00	4	52	38	00	1	8
11	00	4	27	39	00	1	6
12	00	4	5	40	00	1	4
13	00	3	47	41	00	1	2

A TABLE of Refractions.

App. d.	Alt.	Ref.	Corr. "	App. d.	Alt.	Ref.	Corr. "
42	00	1	00	67	03	00	23
43	00	00	58	68	00	00	22
44	00	00	56	69	00	00	21
45	00	00	54	70	00	00	20
46	03	03	52	71	03	00	19
47	00	00	50	72	00	00	18
48	00	00	48	73	00	00	17
49	00	00	47	74	00	00	16
50	00	00	45	75	00	00	15
51	00	00	44	76	00	00	14
52	00	00	42	77	00	00	13
53	00	00	40	78	00	00	12
54	00	00	39	79	00	00	11
55	00	00	38	80	00	00	10
56	00	00	36	81	00	00	9
57	00	00	35	82	00	00	8
58	00	00	34	83	00	00	7
59	00	00	32	84	00	00	6
60	00	00	31	85	00	00	5
61	00	00	30	86	00	00	4
62	00	00	28	87	00	00	3
63	00	00	27	88	00	00	2
64	00	00	26	89	00	00	1
65	00	00	25	90	00	00	0
66	00	00	24				



OF all material Motions, there is none we know of so quick as that of Light, it being so prodigious, that till the present Age, it lay wholly undiscovered; and was look'd upon as instantaneous, 'till Mr. Roemer, first found it out by the Eclipses of *Jupiter's Satellites*, on it Sir *Richard Blackmore*, writes thus:

BEHOLD the Light, emitted from the Sun,
What more familiar, yet what more unknown;
While, with its spreading Radiance it reveals
All Nature's Works, it still itself conceals.
See! how th' effulgent Emanations fly
Thro' the blue Gulph of interposing Sky;
Millions of Miles, so rapid is their Race
To cheer this Earth they in few Moments pass;
Amazing Progress! at its utmost stretch,
What human Mind can this swift Motion reach?

BLACKMORE's Creation.

Of Arithmetical Questions.

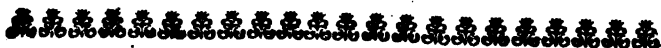
***** Arithmetical Questions are a Sort of Enigmas re-
* A * specting Numbers, and are of various Kinds;
* taking their Names from the several Branches
***** of Mathematics, to which they are applied:
Being denominated either simply Arithmetical, or Alge-
braical, or Trigonometrical, &c. or mixt, viz. requiring
both Algebra and Geometry to solve them: Of which
you will see a Variety in the subsequent Pages, where
every one may find something level with their Capac-
ities; and if the Order in which they are ranged, be not
thought agreeable; I shall be glad to be better instructed
by those who are proper Judges in these Matters.

QUESTION the First, by J. T.

LET us suppose with Mr. *Flamsteed*, that the Para-
lax of the *Orbis Magnus* (or the Angle which the
Diameter

22 Arithmetical Questions to be Answer'd.

Diameter of the Earth's annual Orbit subtends at the nearest of the fixed Stars) is 47 Seconds ; and that the Distance of the Earth from the Sun is (*numero rotundo*) 80000000 Miles, its required to find in what Time a Ray of Light would come from thence to us, reckoning it to move the Semidiameter of the *Orbis Magnus* in $7' : 5''$: And likewise, how long a Cannon Ball would be in passing from the nearest of the fixed Stars to us ; supposing it to run 13 Miles per Minute constantly, without any Diminution of its Velocity.



QUESTION the Second, by J. T.

TWO Men (call for Distinction B and A)
Discours'd thus of their Money by the Way ;
Quoth A to B, what think you I have try'd,
That if your Crowns by mine are multiply'd,
And to the Product then there added be,
Six Hundred Sixty Six : The Cube of mine you'll see.
Says B to A again, I likewise find,
That if the Squares of yours and mine are join'd,
And if from thence you Ninety Five subtract,
There then remains five Times my Crowns exact.
How many Crowns had each, tell me I pray,
You'll quickly find it out by Algebra.



QUESTION the Third, by J. T.

IT is required to find Two such Numbers, that if One of them be multiplied into the Cube of the Other, the Product may be a perfect Square.



QUESTION the Fourth, by J. T.

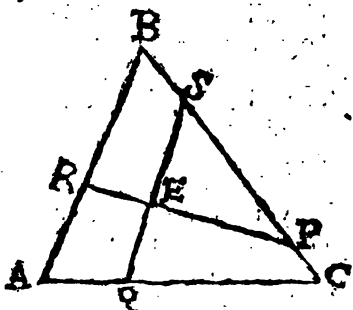
A N Eastern Sage when at the Point of Death,
His four Sons call'd, and did to them bequeath,
The

The all he left, and thus his Speech directs,
 To arm their Minds against its worst Effects.
 Death to the vulgar only harsh appears,
 The ill we feel, is chiefly in our Fears.
 To die, is landing on some silent Shore,
 Where Billows never break, nor Tempests roar,
 And e'er we feel the friendly Stroke, 'tis o'er. }
 Why then are we so fond of mortal Life,
 Beset with Dangers and maintain'd with Strife;
 A Life, which all our Care can never save,
 One Fate attends us, and one common Grave.
 Besides we tread but a perpetual Round,
 We ne'er strike out but beat the former Ground:
 For still we think an absent Blessing best,
 Which cloyes and is no Blessing when possess'd:
 The sev'rish Thirst of Life increases still,
 We call for more, and never have our fill.
 Again we all of us were born to die,
 Why should we then bewail Mortality:
 How many Monarchs with their mighty State
 Who rul'd the World were over-rul'd by Fate!
 The Founders of invented Arts are lost,
 And Wits who made Eternity their Boast:
 Where now is HOMER! who possess'd the Throne,
 Th' immortal Work remains, the mortal Author's gone.
 Why then should we repine to yield our Breath,
 Whose very Life is little more than Death:
 More than one half by lazy Sleep possess'd,
 And when awake, the Soul but nods at best:
 While therefore Life remains, with studious Care
 For Death (which soon will come) your selves prepare.
 My small paternal Field to you I leave,
 An equal Share each of you shall receive }
 According to the Rules I under give.
 This said a Mist came swimming o'er his Sight,
 And seal'd his Eyes in everlasting Night.
 Ye Sons of Art I pray exert your Skill,
 And tell 'em how to satisfy the Will.



24 *Arithmetical Questions to be Answered.*

THE Field is triangular ; its three Sides known, viz.
 $AB = 62.$ $BC = 71.$
 $CA = 67.$ Perches. See
the Figure annext.



And is to be divided into four equal Parts by two
Lines, as QS , PR intersecting each other at right
Angles.



QUESTION the Fifth, by R. F.

LET the transverse Diameter of an *Ellipsis* be equal
to 50 Feet, and the Conjugate 30. It's requir'd to
inscribe therein the greatest Trapezoid possible, two of
whose Sides shall be Ordinates, rightly apply'd to the
principal Axis, and in Proportion to one another as 5 to 3.



QUESTION the Sixth, by R. F.

GIVEN the Area of a Circle equal to 3848. 46 Square
Feet, and therein let a *Trapezium* be inscribed,
whose Diagonals are given, viz. 62. and 64. Feet ; and
the Angle they form by their Intersection 104 : -- De-
grees requir'd to find the Sides of the *Trapezium*.



QUESTION the Seventh, by J. T.

SURELY the Man, who, first in hollow Wood,
Tempted, adventurous, the briny Flood,

In

In harden'd Oak his fearless Heart did hide,
 And Ribs of Iron arm'd his Side.
 He not th' impetuous Winds contending Roar
 Did dread; nor Billows beating on the Shore.
 What Form of Death could ever him affright,
 Who, unconcern'd, with steadfast Sight,
 Could view the Surges rising Mountain steep,
 And Monsters rolling in the liquid Deep:
 Could through the numerous Ranks of Ruin go,
 With stormy Winds above, and Rocks below,
 Without the *Magnet's* Aid, his Course to show?
 The Northern Polar Star his only Guide,
 Which from his Sight the Clouds did often hide,
 Mighty Advantages in their Employ,
 Our Modern Navigators do enjoy,
 'Bove what the Antients had, we all must own,
 Since the Magnetic Needle's Use was known;
 Nor only this, but the learn'd Labours view
 Of *Wright, Mercator, Wallis, Halley*, too:
 Whose Praise to future Ages may some Wit,
 In Numbers equal to their Fame transmit.
 YET in the Sailing we *Mercator's* call,
 * Two Cases still remain (if not by all)
 By most as unsurmountable are thought,
 Nor to the common Rules can e'er be brought;
 Yet does the Noble Analytic Art,
 In order thereunto some help impart,
 To the Ingenious then I will apply,
 In Algebra who vers'd their Skill may try,
 And to the World unfold the Mystery.

 * Viz. One Latitude, departure, and difference of Longitude, and
 One Latitude, distance, and difference of Longitude.

E X A M P L E.

A Ship sets out from a Port in the Latitude of 54 Degrees North, and sails upon an unknown Course between the South and West, till her Departure be 44. 45 Miles, and her difference of Longitude 74. 17 Miles, requir'd her Course, distance Run, and difference of Latitude. Again, a Ship sets out from a Place in the above mention'd Latitude, and sails in the same Manner 80 Miles, and then finds her difference of Longitude to be 74. 17 Miles, required her Course, Departure, and difference of Latitude.

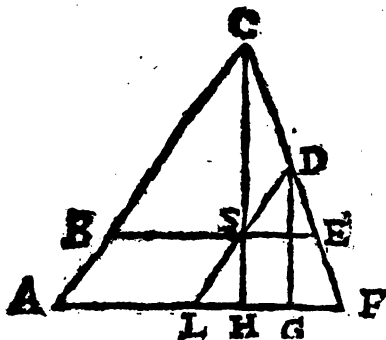
QUESTION



QUESTION the Eighth, by R. F.

IN the Oblique-angled Triangle *A C F* (*vide the Figure below*) there is given *B S* equal to 20 Poles ; and *D G* equal to 22 ; and *H F* equal to 16, ditto : And the Line *B E* drawn paralel to the Base *A F* bisects the Area of the Triangle ; also the Line *D L* is the shortest that can be drawn through the Point *S*, to terminate in the Sides *F C*, *F A*. Required the Sides of the Triangle.

N. B. That *C H* and *D G* are Perpendicular to the Base *A. F.*



QUESTION the Ninth, by J. T.

IN a certain unknown Northern Latitude, the Declination of a Comet was observ'd to be $38^{\circ} : 32'$ *Northerly*, and its Amplitude at setting was found Four Points and a Half, or $50^{\circ} : 37'$ more *Northerly*, than the setting Amplitude of *Aldebaran*, required the Latitude of the Place where these Observations were made.

QUESTION

QUESTION the Tenth by J. T.

WHEN tir'd with Business, or perplex'd with Care,
 Or minded am to breathe in purer Air ;
 I to my Garden straightway then retire
 To sooth my Cares, and Nature's Works admire :
 Here the Carnation and the bashful Rose,
 Their Virgin Blushes to the Sun disclose :
 There the chaste Lilly rises to the Light,
 Unveils her snowy Breast, and charms the Sight.
 Here a Meandering Rivulet gently flows,
 And a new Heaven in its fair Bosom shows, }
 Inviting by its Murmurs soft Repose.
 Two lofty Trees within the Garden stand
 (Upright and streight) which o'er the rest command :
 Between each Tree when measur'd on the Ground
 In a streight Line, just forty Yards are found,
 The higher Tree does sixty Yards contain,
 Thirty the lower, (both stand on a Plain :)
 Betwixt the Trees a Fountain plac'd must be
 But so ; that when from it to th' Apex of each Tree
 Two Lines are drawn, the Angle they contain,
 Must be the greatest possible it * can.
 He who by Fluxions resolves this Question true, }
 And gives a Geometrick Construction too,
 To him I'll own that Thanks are justly due.



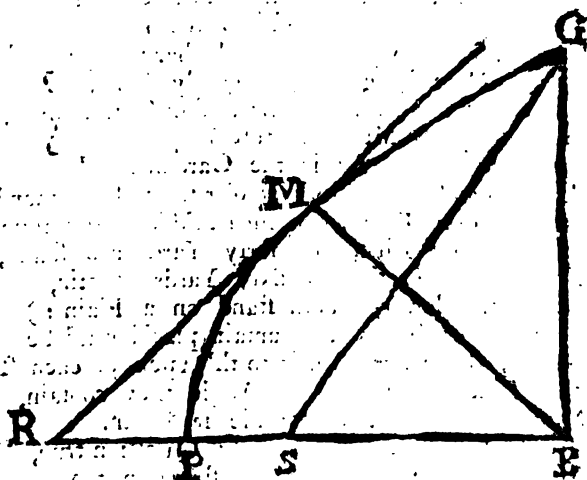
QUESTION the Eleventh, by J. T.

DR. EDMUND HALLEY in his Cometography,
 says, That the COMET which appeared in the Year
 1686, (which he supposes to move in a *Parabolic Tra-*
jectory,) its Perihelium Distance from the Sun was 325,
 such Parts as the mean Distance of the Earth from the



* i. e. The greatest Angle that can be formed by two right
 Lines drawn from any Point in the Line of Distance, to the
 Vertices of the said Trees.

Sun is 1000. Suppose now the COMET to be in such a Part of its Orbit G , that the Area $G P S$ is equal to 492916 ^{3d} such Square Parts; and letting fall the Semi-ordinate $G B$ upon the Axis, its required to draw the Line $B M$ to such a Point of the Curve, so that the Angle contained by the Line $B M$, and a Tangent drawn to the Point M , (*viz.* the Angle $B M R$) may be a maximum.



To the above I will add, two more Questions which were some Years ago proposed in the LADIES DIARY; the first was there given unlimited, and the latter never had a true Algebraic Solution given to it hitherto; for though we commonly reckon a Question solv'd when it is brought to an Equation, wherein there is only one unknown Quantity, yet in some Cases it is otherwise, *viz.* when it happens to be an Exponential Equation as $x^x = 2$. we then are obliged to have recourse to other Methods, the common Rules of Algebra here failing us. The first of the Questions I have limited, by fixing it to a particular Latitude, and the latter of 'em will, I doubt not (now Algebra and the higher Geometry are better known and understood) be truly answer'd by several directly, without guessing it by repeated Trials.

QUESTION

QUESTION the Twelfth.

IN the North Latitude of Fifty Three, } 53° 10'
 As I with some Ladies was drinking of Tea,
 The Room it was pleasant, and the First Day
 [of May]

I happen'd to applaud their bright Genius and Wit,
 Yet thought Mathematicks for them not so fit;
 But nettl'd at this was a learned brisk Lass,
 And the Sun shining plain on a Specular Glass,
 Toth' Top o'th' East Corner of the Room came the Rays,
 Let's see by your Learning? she answering prays;
 This Glass is i'th' Middle o'th' Wall I do find,
 Horizontally plac'd, which stands to th' South Wind,
 The Area o'th' End of the Room I here show, [80 Sq. Feet]
 The whole Room's Dimensions from hence I wou'd know
 With the Time of the Day? But I'll tell you below,
 That the Height of the Sun is exactly the same
 As his Azimuth, I truly do find by the Beam.
 A Dish of the Best shall then be your due,
 If you to this Quere a Solution give true.

QUESTION the Thirteenth.

A Gentleman as he did ride,
 Near to a pleasant Common Side,
 Some Shepherdesses chanc'd to meet
 Driving their Flocks, whom he did greet:
 God speed you well, and may you be
 As happy as you're fair, quoth he!
 Prosper your Flocks, and may they thrive,
 Tell me how many Sheep you drive.

ONE of the Damsels straight reply'd,
 Sir you shall soon be satisfy'd;
 For if the Flock we should divide
 Amongst us equally, each share
 Is twice the Number we Maids are;

E

But,

But, if for One of us you do
 Count one Sheep, for the next count Two ;
 For the Third, Four ; for the Fourth, Eight ;
 So doubling at each Maid aright ;
 At the last Maid, the Sum would be
 As many as the Sheep you see :
 From what I've said, I make no doubt,
 You soon will find the Numbers out.

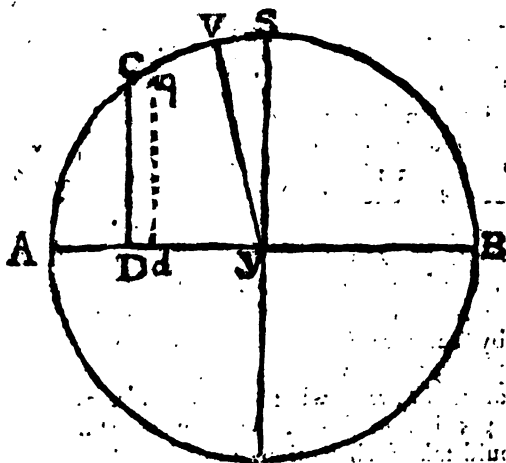


Q U E S T I O N the Fourteenth, by J. T.

IT is required to find a Curve, the Sub-Normal of which is equal to an invariable Line. *a*.

I should here have concluded, had not a small Treatise wrote by one *T. Baxter*, accidentally fallen into my Hands ; in which he pretends to say (not indeed to prove, for there is not a Demonstration in the whole Book) that he has found out the Quadrature of the Circle in finite Terms, *viz.* that if the Diameter be equal to 1 ; the Circumference is 3.0625. the chief Reason, if I may so call it which he gives for his Assertion is, that there may be several Figures different in Form, yet equal with Regard to their Areas ; and if so, why may not a Circle and a Square be also. This though, it be very true in some particular Cases, cannot be affirmed of Universals ; we grant that a Square whose Side is 12. is exactly equal to a Rectangle, one of whose Sides is 16, and the other 9. Or that a Parabola, the Abscissa of which is 60, and the corresponding Ordinate 40, is equal to a Rectangle, one of whose Sides is 80, and the other 20, because they are demonstrable ; but we cannot say the same of a Circle and a Square. Again, supposing it were possible to find the Ratio of a Circle's Diameter to its Circumference in finite Terms, yet surely Mr. *Baxter*, has not found it ; who says they are in Proportion as 1. to 3.0625 this will appear false to any one who consults Page 348, of *Ward's, Young Mathematicians Guide*, where he proves,

That



That if a regular Polygon of 258280326 Sides be inscribed in a Circle, whose Radius is Unity, its Periphery will be equal to 6.28318530717958 : But the Circumference of the Circle must necessarily be greater than that of its inscribed Polygon, consequently the Diameter of a Circle is to its Circumference as 1 to 3.14159265358979 nearly. I shall annex to this another Demonstration, which is deduced from the Principles of Fluxions. Let $AD = x$; and CD be the Sine of 30 Degrees $= y$ ($= .5$) Radius equal to Unity, (for I suppose that every one who knows what a Circle is, knows also that the Side of a regular Hexagon inscrib'd in a Circle is equal to the Radius; but the right Sine CD is equal to half the Side of the Hexagon consequently $= .5$) now by the Property of the Circle $2x - xx = yy$ which in Fluxions is $2\dot{x} - 2x\dot{x} = 2y\dot{y}$; and $\dot{x} = y\dot{y}$

$\frac{y^2}{1 - x}$: This Squared will give

$\frac{\dot{x}^2}{xx - 2x + 1}$: Equal to $\frac{y^2 \dot{y}^2}{1 - yy}$; (because

by the Equation of the Curve $2x - xx = yy$.) The Fluxion of the Arch AC is $= \sqrt{\dot{x}^2 + \dot{y}^2}$

$$= \sqrt{\frac{y^2 y^2}{1 - yy} + y^2} = \sqrt{\frac{y^2 y^2 + y^2 - y^2 y^2}{1 - yy}}$$

$$= \sqrt{\frac{y^2}{1 - yy}} \text{ equal to } y \sqrt{\frac{1}{1 - yy}} : \text{ This Surd}$$

thrown into an infinite Series, and multiplied by y , and the Fluent of every Term found will give

$$y + \frac{y^3}{6} + \frac{3y^5}{40} + \frac{5y^7}{112} + \frac{35y^9}{1832} + \frac{63y^{11}}{2816}$$

&c. equal to the Length of the Arch A C. Now if we take only five Terms of the Series without carrying it further on, we shall find A C equal to .525585 and this multiplied by 12, because the Arch A C is a twelfth Part of the Periphery, will give 6,2830, &c. equal to the Circumference of that Circle, whose Diameter is 2. which is as 1 to 3.1415 before found. It is wonderful to me, that Men should take such Notions into their Heads, and then endeavour to propagate them for Truths without a more mature Examination; had Mr. *Baxter* lived in the 11th or 12th Centuries, when Ignorance was in its Meridian, perhaps his Opinion might have been swallowed by some; but in an Age like ours, where even Sir *Isaac Newton's* Word would not be taken without a Demonstration, in a Mathematical Theorem he must expect no Followers: I am informed that Mr. *Baxter* was advised by some of his Friends, not to print this Treatise, but he persisted in it, which shews how much Men are bigotted to their own Sentiments, and proves the Truth of the old Proverb, *Amor sui cæcus*. But further, it is to be observed, that Mr. *Baxter* is only the Second Inventor of the Quadrature of the Circle; for a certain *Frenchman* has, several Years ago published in the Memoirs of the Royal Academy of Sciences, that after Five and Twenty Years Study, he had found out the Ratio betwixt the Diameter and Periphery in finite Terms. Before I leave off, I must take Notice of a Scheme which I have seen, subscribed *I. Hemingway*, which was designed (I do suppose) for a Confutation of Mr. *Baxter's* Assertion, but he also runs into a great Error, and is no more likely to convince Mr. *Baxter*, than the other is to persuade him; for he requires that we grant him those very Things which he ought to have demonstrated, and which he does.

Now multiply this Root by y and it will give

$$\begin{array}{ccccccccc} y + y^2 & y + 3y^2 & y + 5y^2 & y + 35y^2 & y + 63y^2 & & & & \\ \hline & 2 & 8 & 16 & 128 & 256 & & & \&c. \end{array}$$

and the Fluent of this is at Sight evidently.

$$\begin{array}{ccccccccc} y + y^2 & y + 3y^2 & y + 5y^2 & y + 35y^2 & y + 63y^2 & & & & \\ \hline & 6 & 40 & 112 & 1152 & 2816 & & & \&c. \end{array}$$

The reducing of fractional Quantities and Surds to an infinite Series, by Division and Extraction, is of the utmost Consequence in a great many Problems, whose Solution we may have occasion to find by Fluxions; as also the Method of Reversion of Series, or extracting the Root of an infinite Equation, invented by Sir *Isaac Newton*: They frequently occurring in Practice, as in the finding the Length of Curve Lines, or investigating the Value of the Ordinate, or Abscissa of any Curve from the Area or Length of the Arch given, so that I would recommend to every Person who has a Desire to be something more than superficially versed in the Mathematicks, to make himself thorough Master of them; and by frequent Practice he will soon attain his End, although at first Sight they appear difficult, and abstruse. I may also add, that their Use is very great in all Exponential Equations, such as

$x^x = n$ because these cannot be resolved without the help of Logarithms, and the Value of no Logarithm can be had without an infinite Series; and now I mention Exponential Equations, I cannot but take Notice of a Passage in Mr. *Leibnitz* Letter of the 20th of June, 1667, to Mr. *Oldenburg*, wherein he speaks of them thus: "There
" are another kind of Problems, which it is not yet in my
" Power to resolve, of which see an Example: Let
" there be two Equations $x^x + y^y = xy$; and
" $x^x - y^y = x + y$, here are two Equations given, to
" find the two unknown Quantities x and y . To solve
" such Problems as these either by Numbers or Lines,
" I think a very difficult Task; if Mr. *Newton*, by the
" Force of his superior Genius, can give any Light to this
" difficulty, he will greatly promote *Analysis*. And a little after — I should be very glad to know his Sentiments about the Resolution of the Equations above-mention'd, to wit, where the Exponent is an unknown Quantity.

I have

I have never met with any such Problems resolv'd any where to this Day, so 'tis probable they are yet among the Desiderata in Mathematicks.



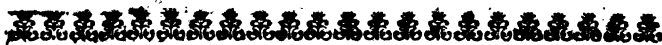
To all LOVERS of INGENUITY.

THE AUTHOR, intending to publish the next Quarterly Book the Beginning of *June* ensuing, desires that such Gentlemen and Ladies, &c. as think fit to encourage this Undertaking, either by promoting and recommending the Sale thereof, or by sending such Subjects either in Verse or Prose, as are suitable to this Design, would please to direct their Letters to Mr. THOMAS GENT, Printer, near the *Star* in *Stonegate*, YORK, Post paid, before the End of *May* next, where they will be carefully forwarded to the AUTHOR.

WHOEVER send either *Ænigmas*, or Arithmetical Questions, are desired to give the Solutions along with them, to prevent all Mistakes, or Ambiguity in the Terms. And I do assure the Buyers of this Treatise, that, in Process of Time, they shall have Questions in all the Branches of Mathematicks, viz. Arithmetical, Nautical, Geographical, Mechanical, Trigonometrical, Astronomical, Algebraical, and in Fluxions, together with Exponential Equations, and the Construction of Algebraic Equations, and finding their *Loci*; to suit the Tastes of all Persons, and render the WORK generally useful.

*Vive, vale ; si quid novisti rectius istis,
Candidus imperti : si non, bis utere mecum.*





A D V E R T I S E M E N T.

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*Contemptum Stulci contemnere Dindime laus est
Contemni a Stulto dedecus esse nego.*

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V. Dr Bostock's Famous, Never-failing, Purgings Cordial Elixir, (prepared from the Original Receipt by Mr John Parker of London) the great Restorative and Preservative of Health, at Two Shillings and Six Pence the Half Pint Bottle, and Fifteen Pence the Quartern, with a Sheet of proper Directions concerning the Cure of Chronical Distempers, Diseases of the Head, Breast, &c. Jaundice, Dropsy, Scurvy Melancholly Vapours, Green-Sickness, Obstruction, Cholick, Griping, Rheumatism, (Preservative from the Gout) Surfeits, Stone and Gravel, and intermitting Fevers. To prevent Counterfeits, Mr. Parker's Seal, with three Stags, and his Name round it; as above mark'd, will be affix'd to each Bottle.



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O R,
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FOR THE
Ingenious of Both Sexes.

For the MONTHS of APRIL,
MAY, and JUNE, 1734.

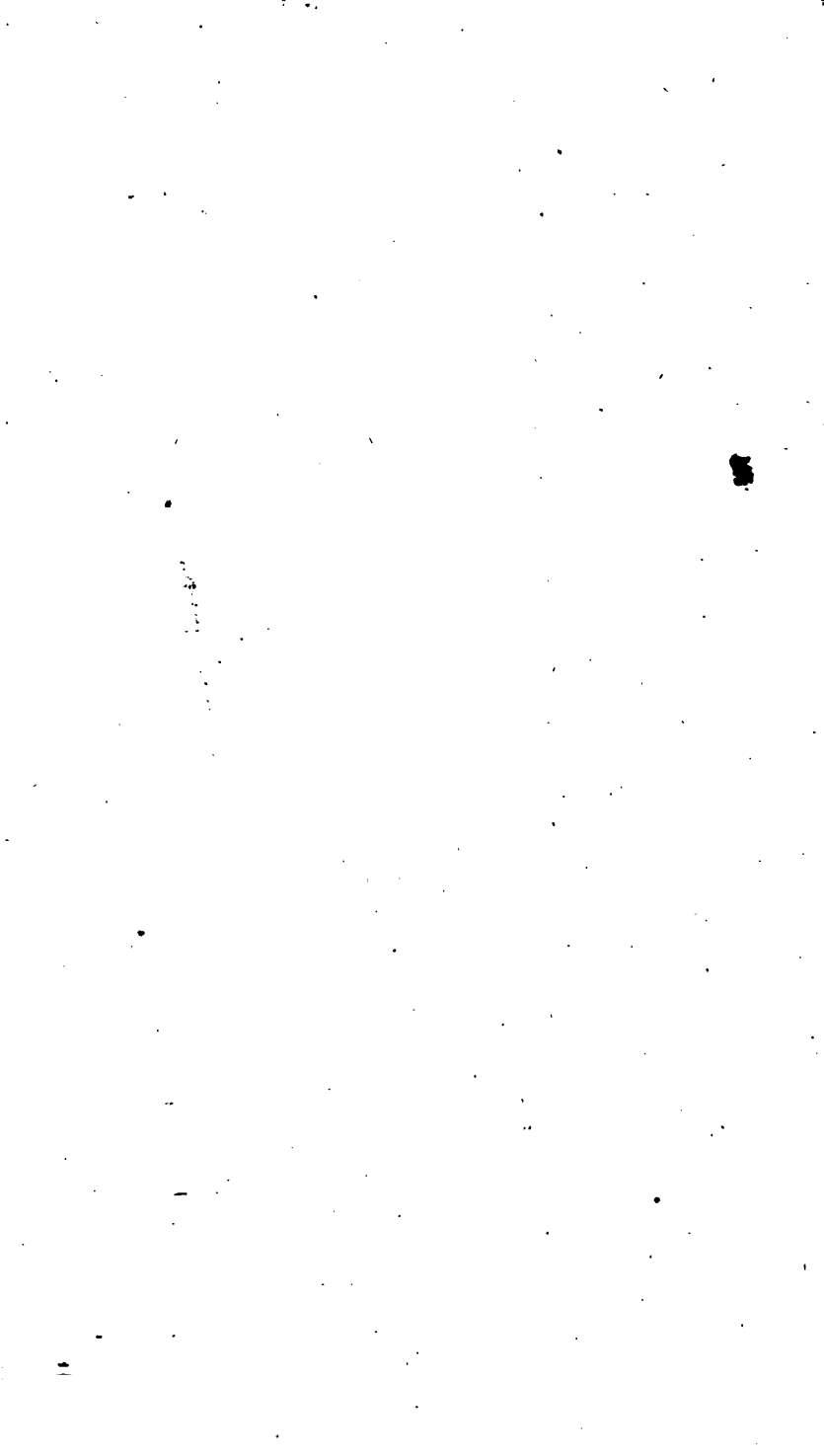
CONTAINING,
I. ENIGMA'S. II. MATHEMATICAL
QUESTIONS. Suited both to Begin-
ners, and also to such as have made
higher Advances in those STUDIES.

*Me vero primum dulces ante omnia Musæ,
Quarum sacra sero ingenti, perculsus Amore,
Accipiant : Cœlique Vias & Sydera monstrent,
Defectus Solis varios, Lunæque Labores :
Unde Tremor Terris : quæ Ki maria alta tumescant
Objicibus ruptis, rursusque in se ipsa residant :
Quid tantum Oceano properent se tingere Soles
Hyberni, vel quæ tardis mora Noctibus obster.*

VIRGIL. Georgic.



YORK : Printed by THOMAS GENT : And
Sold by J. WILFORD, behind the Chapter-House
in St. Paul's Church-Yard, LONDON, 1734.





T H E P R E F A C E.

***** *In the Preface to the last Book, I gave an Account*
 I ***** *of the Usefulness of Mathematicks in general :*
 ***** *I shall now do it with Regard to Particulars.*
And,

1st, Of ARITHMETICK, which is undoubtedly the most extensive and necessary of all others : Without this, Trade and Commerce would soon be at an End, and the other Branches of the Mathematicks uncertain and defective.

2dly, TRIGONOMETRY : By this Science we come to the Knowledge of a vast many Things of absolute Importance to Mankind : Hereby we understand the Motions, Distances and Figures of Celestial Bodies ; by its Assistance Geographers measure the Distances of Places situate upon the Surface of the Earth ; and on this Art does Navigation entirely depend, it being necessary to determine the Position of the Ship, either with Regard to the Place sailed from, or the Port intended for, by a Trigonometrical Calculation : In a Word it is impossible to live well without it ; and the most useful Parts of Knowledge would be utterly lost, if Mankind were ignorant of it. PLATO was wont to say, That ARITHMETICK and TRIGONOMETRY were the two Wings on which the Mind of Man mounted itself up to the Heavens ; meaning thereby, their Usefulness in determining the Motions, and discovering the Harmony of the Celestial Bodies.

3dly,

edly, GEOMETRY : By this Science we learn to compare Magnitudes and Measures, and thereby discover the Ratio, or Habitudo, one Thing bears unto another. There is no State of Life, which does not require the Use of Measures ; all the Arts, which tend to the supplying of Mankind with Food and Raiment, subsist only by Measures of Lengths, Breadths, Circles, Squares, &c. and the Capacities of dry and liquid Things, and their Reductions. Take away Geometry from any Art, either Liberal or Mechanic, and you take away its Soul or Reason ; that is, you destroy it. 'Tis pretended, the Egyptians were the first Inventors of GEOMETRY, because they were the first that were under any Necessity of preserving the Limits and Extent, of their Lands and Possessions, either by Figures traced and delineated, or by Accounts and Memorials contain'd in Writing, the Inundations of their Lands by the Overflowing of the NILE effacing all other Marks. Yet, (as an ingenious Author remarks) as there was the same Necessity for it before the Low Parts of EGYPT were inhabited, since there was no making any Division, without taking the Measures of the whole, and of each Part ; nor any building of Houses or Towns, without considering their Figures, and regulating them by Measures : 'Tis to be presumed, that the Science of Measuring is as old as the World. Man took from himself the Measures of all other Things ; he did not borrow from without the Names of Fathoms, Cubits, Feet, Handbreadths, Inches, &c. but he apply'd his Thumb, his Hand, his Feet, or his Arms, to the Things he would measure ; and so took from his own Body the Dimensions of all other Things. VITRUVIUS says, That the Græcians, through an Excess of Delicacy in Building, did not only take the Parts of Humane Bodies for the common Standard of their Plans and Draughts, but even the Beauty of Human Bodies for the Model of their Architecture : And hence they formed the Corinthian Order, from the beautiful Proportion of a well-shaped Woman ; the Ionic, from the Shape of a handsome well-proportioned Man ; and the Doric, from the Shape of a labouring Man, strong and robust. Man imagined himself the most perfect of created Beings, and so proposed his own Body as the Model and Measure of all others.

4thly, ALGEBRA, which is of great Use in helping us to distinguish the Relations of different Species of Quantities, and investigating of Theorems: It is a Method of Reasoning by the Help of Letters, representing Quantities, and is to the Mathematicks, the same that Logic is to the ordinary Philosophy, and is therefore sometimes called Logistic.

5thly, The Analysis of INFINITES, or FLUXIONS, which is only a different Method of using the Characters of Common ALGEBRA; by which admirable Invention of the Great Sir Isaac Newton, we are much assisted in every Part of the Mathematicks. This is One of the most sublime Discoveries the World was ever yet acquainted with, and perhaps we may expect no further. " 'Tis a pleasant Thing (says Mr. DITTON) to contemplate the several Gradations and Steps made in the Improvement of this Method: The old Geometers used the Method of Exhaustions to admirable good Purpose; but this, after a long Tract of Time, gave Place to a superior one; namely, that of Indivisibles. And in much less Time, was this improved and heightened into the noble Arithmetick of Infinites. And (Geometry being now in hasty Growth towards its Maturity) in a very short Time the Method of Fluxions appeared.

" But what a wide Step is it from the Method of Exhaustions hither? How humble and low was the glorious Structure, when the first ARCHIMEDES left it, in Comparison to what it is, now the SECOND has set his finishing Hand to it? If there are none, who consider these Things without Wonder and Delight, there are some who go farther, and are ready to ask the Question, Whether the next Step will not be to the Algebra of Pure Intelligences? However that be; 'tis certain, this Method helps a Man to arrive at Truth, by a most easy, cheap, and compendious Way. And it is for that very Reason, by so much more perfect than all others, by how much the fewer (and those more facile) Steps, it takes to obtain its End. All the Works of Nature have a charming Simplicity and Conciseness in them: And there is so
" much

" much of that Beauty here, that this alone were sufficient
 " to recommend it for the genuine Offspring of Eternal
 " Truth and Reason."

MAY the 25th, 1734.



Advertisement to all Lovers of Ingenuity.

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Miscellanea



Miscellanea Curiosa, &c.



A CONTINUATION of Dr. R. COTES'S P R E F A C E.

IF the Bodies of the Planets and Comets are carried round the Sun in Vortices; the Bodies so carried, and the Parts of the Vortices next surrounding them, must be carried with the same Velocity and the same Direction, and have the same Density, and the same *Vis Inertiae*, answering to the Bulk of the Matter. But it is certain, the Planets and Comets, when in the very same Parts of the Heavens, are carried with various Velocities, and various Directions. Therefore it necessarily follows, that those Parts of the Cælestial Fluid, which are at the same Distances from the Sun, must revolve at the same time with different Velocities, in different Directions: For one kind of Velocity and Direction is required for the Motion of the Planets, and another for that of the Comets. But since they cannot be accounted for, we must either say, that all the Cælestial Bodies are not carried about by Vortices, or else that their Motions are derived, not from one and the same Vortex, but from distinct ones, which fill and pervade the Spaces round about the Sun.

BUT if several Vortices are contained in the same Space, and are supposed to penetrate each other, and to revolve with different Motions; then because these Motions must agree with those of the Bodies carried about by them, which are perfectly regular, and performed in
Conic-

Conic-Sections, which are sometimes very Eccentric, and sometimes nearly Circles; one may reasonably ask, how it comes to pass, that these Vortices remain entire, and have suffered no Manner of Perturbation in so many Ages from the Actions of the conflicting Matter. Certainly, if these fictitious Motions are more compounded, and more hard to be accounted for, than the true Motions of the Planets and Comets, it serves to no Purpose to admit them into Philosophy; since every Cause ought to be more simple than its Effect. Allowing Men to indulge their own Fancies, suppose any Man should affirm, that the Planets and Comets are surrounded with Atmospheres like our Earth; which Hypothesis seems more reasonable than that of Vortices. Let him then affirm, that these Atmospheres by their own Motion move about the Sun, and describe Conic Sections, which Motion is much more easily conceived, than that of the Vortices penetrating each other. Lastly, that the Planets and Comets are carried about the Sun by these Atmospheres of theirs, and then applaud his own Sagacity in discovering the Causes of the Caelestial Motions. He that rejects this Fable, must also reject the other; for two Drops of Water are not more alike, than this Hypothesis of Atmospheres, and that of Vortices.

GALILEO has shewn, that when a Stone projected moves in a Parabola, its Deflexion into that Curve from its Rectilinear Path is occasioned by the Gravity of the Stone towards the Earth, that is, by an occult Quality. But now somebody, more cunning than he, may come to explain the Cause after this Manner. He will suppose a certain subtle Matter, not discernable by our Sight, our Touch, or any other of our Senses, which fills the Spaces that are near, and contiguous to the Superficies of the Earth; and that this Matter is carried with different Directions, and various, and often contrary Motions, describing Parabolic Curves. Then see how easily he may account for the Deflexion of the Stone above spoken of. *The Stone, says he, floats in this subtle Fluid, and following its Motion, can't chuse but describe the same Figure. But the Fluid moves in Parabolic Curves; and therefore the Stone must move in a Parabola of Course.* Would not the Acuteness of this Philosopher be thought very extraordinary,

dinary, who could deduce the Appearances of Nature from mechanical Causes, Matter and Motion, so clearly, that the meanest Man may understand it ? Or indeed should we not smile to see this new *Gallileo* taking so much Mathematical Pains to introduce occult Qualities into Philosophy, from whence they have been so happily excluded ? But I am ashamed to dwell so long upon Trifles.

THE Sum of the Matter is this : The Number of the Comets is certainly very great ; their Motions are perfectly regular ; and observe the same Laws with those of the Planets. The Orbits, in which they move, are Conic Sections, and those very eccentric. They move every Way towards all Parts of the Heavens, and pass through the Planetary Regions with all possible Freedom ; and their Motion is often contrary to the Order of the Signs. These Phenomena are most evidently confirmed by Astronomical Observations, and cannot be accounted for by Vortices. Nay indeed, they are utterly irreconcilable with the Vortices of the Planets. There can be no Room for the Motions of the Comets, unless the Cælestial Spaces be entirely cleared of that fictitious Matter.

FOR if the Planets are carried about the Sun in Vortices ; the Parts of the Vortices, which immediately surround every Planet, must be of the same Density with the Planet, as was shewn above. Therefore all the Matter contiguous to the *Perimeter* of the *Orbis Magnus*, must be of the same Density with the Earth. But that which lies between the *Magnus Orbis*, and the Orb of *Saturn*, must have either an equal or greater Density. For to make the Constitution of the Vortex permanent, the Parts of less Density must lie near the Centre, and those of greater Density must go farther from it. For since the periodic Times of the Planets are in the Sesquiplicate Ratio of their Distances from the Sun, the Periods of the Parts of the Vortices must also preserve the same Ratio. Thence it will follow, that the centrifugal Forces of the Parts of the Vortex must be reciprocally as the Squares of their Distances. Those Parts therefore, which are more remote from the Centre, endeavour to recede from it with less Force ; whence, if their Density be deficient, they must yield to the greater Force with which the Parts that

4 MISCELLANEA CURIOSA &c.

lie nearer the Centre endeavour to ascend. Therefore the denser Parts will ascend, and those of less Density will descend; and there will be a mutual Change of Places, till all the fluid Matter in the whole Vortex be so adjusted and disposed, that, being reduced to an *Equilibrium*, its Parts become quiescent.

IF two Fluids of different Density be contain'd in the same Vessel; it will certainly come to pass, that the Fluid of greater Density will sink the lowest; and by a like Reasoning it follows, that the denser Parts of the Vortex, by their greater centrifugal Force, will ascend to the highest Places. Therefore all that far greater Part of the Vortex, which lies without the Earth's Orb, will have a Density, and by Consequence a *Vis Inertiae*, answering to the Bulk of the Matter, which cannot be less than the Density and *Vis Inertiae* of the Earth. But from hence will arise a mighty Resistance to the Passage of the Comets, and such as can't but be very sensible; not to say, enough to put a Stop to, and absorb their Motions entirely. But now it appears, from the perfectly regular Motion of the Comets, that they suffer no Resistance that is in the least sensible; and therefore that they meet with no Matter of any kind, that has any resisting Force; or, by Consequence, any Density, or *Vis Inertiae*. For the Resistance of *Mediums* arises, either from the *Inertia* of the Matter of the Fluid, or from its Want of Lubricity. That which arises from the Want of Lubricity is very small, and is scarce observable in the Fluids commonly known, unless they be very tenacious like Oil and Honey. The Resistance we find in Air, Water, Quick-Silver, and the like Fluids that are not tenacious, is almost all of the first kind; and cannot be diminished by a greater Degree of Subtlety, if the Density and *Vis Inertiae*, to which this Resistance is proportional, remains: As is most evidently demonstrated by Sir ISAAC NEWTON, in his noble Theory of Resistances, in the Second Book of his *Phil. Nat. Princ. Math.*

BODIES, in going on through a Fluid, communicate their Motion to the ambient Fluid by little and little, and by that Communication lose their own Motion, and by losing it are retarded. Therefore the Retardation is proportional to the Motion communicated; and the commu-
nicated

nicated Motion, when the Velocity of the moving Body is given, is as the Density of the Fluid ; and therefore the Retardation or Resistance will be as the same Density of the Fluid ; nor can it be taken away, unless the Fluid, coming about to the hinder Parts of the Body, restore the Motion lost. Now this cannot be done, unless the Impression of the Fluid on the hinder Parts of the Body be equal to the Impression of the Fore Parts of the Body on the Fluid ; that is, unless the relative Velocity, with which the Fluid pushes the Body behind, is equal to the Velocity with which the Body pushes the Fluid ; that is, unless the absolute Velocity of the recurring Fluid be twice as great as the absolute Velocity with which the Fluid is driven forwards by the Body ; which is impossible. Therefore the Resistance of Fluids, arising from their *Vis Inertiae*, can by no Means be taken away. So that we must conclude, that the Cælestial Fluid has no *Vis Inertiae*, because it has no resisting Force ; that it has no Force to communicate Motion with, because it has no *Vis Inertiae* ; that it has no Force to produce any Change in one or more Bodies, because it has no Force wherewith to communicate Motion ; that it has no Manner of Efficacy, because it has no Faculty wherewith to produce any Change of any kind. Therefore certainly this Hypothesis may be justly called ridiculous, and unworthy a Philosopher ; since it is altogether without Foundation, and does not in the least serve to explain the Nature of Things.

THOSE, who wou'd have the Heavens filled with a fluid Matter, but suppose it void of any *Vis Inertiae*, do indeed in Words deny a *Vacuum*, but allow it in Fact. For since a fluid Matter of that kind can no ways be distinguished from empty Space ; the Dispute is now about the Names, and not the Nature of Things. If any are so fond of Matter, that they will by no Means admit of a Space void of Body ; let us consider, where they must come at last.

FOR either they will say, that this Constitution of a World, every where full, was made so by the Will of God to this End, that the Operations of Nature might be assisted every where by a subtle *Æther* pervading and filling all Things ; which cannot be said however, since we have shewn, from the *Phænomena* of the Comets, that this *Æther* is of no Efficacy at all ; or they will say, that it became

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so, by the same Will of God, for some unknown End ; which ought not to be said, because for the same Reason a different Constitution may be as well supposed ; or, lastly, they will not say, that it was caused by the Will of God, but by some Necessity of its Nature. Therefore they will at last sink into the Mire of that infamous Herd, who dream that all Things are governed by Fate, and not by Providence ; and that Matter exists by the Necessity of its Nature always, and every where, being infinite and eternal. But, supposing these Things, it must be also every where uniform ; for Variety of Forms is entirely inconsistent with Necessity. It must be also unmoved ; for if it be necessarily moved in any determinate Direction, with any determinate Velocity, it will, by a like Necessity, be moved in a different Direction, with a different Velocity ; but it can never move in different Directions, with different Velocities ; therefore it must be unmoved. Without all doubt, this World, so diversify'd with that Variety of Forms and Motions we find in it, could arise from nothing but the perfectly Free Will of God directing, and presiding over all.

FROM this Fountain it is, that those Laws, which we call the Laws of Nature, have flow'd ; in which there appear many Traces indeed of the most wise Contrivance, but not the least Shadow of Necessity. These therefore we must not seek from uncertain Conjectures, but learn them from Observations and Experiments. He who thinks to find the true Principles of Physics, and the Laws of natural Things by the Force alone of his own Mind, and the internal Light of his Reason, must either suppose that the World exists by Necessity, and by the same Necessity follows the Laws proposed ; or, if the Order of Nature was established by the Will of God, that himself, a miserable Reptile, can tell what was fittest to be done. All sound and true Philosophy is founded on the Appearances of Things ; which, if they draw us, never so much against our Wills, to such Principles as do most clearly manifest to us the most excellent Counsel and supreme Dominion of the All-wise and Almighty Being ; those Principles are not therefore to be laid aside, because some Men may perhaps dislike them. They may call 'em, if they please, Miracles or occult Qualities ; but Names maliciously

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maliciously given ought not to be a Disadvantage to the Things themselves ; unless they will say at last, that all Philosophy ought to be founded in *Atheism*. Philosophy must not be corrupted in Complaisance to these Men ; for the Order of Things, will not be changed.

FAIR and equal Judges will therefore give Sentence in Favour of this most excellent Method of Philosophy, which is founded on Experiments and Observations. To this Method it is hardly to be said or imagined, what Light, what Splendor, hath accrued from the admirable Works of the illustrious Sir *Isaac Newton* ; whose happy and sublime Genius, resolving the most difficult Problems, and reaching to Discoveries of which the Mind of Man was thought incapable before, is deservedly admired by all those who are somewhat more than superficially versed in these Matters. The Gates are now set open ; and by his Means we may freely enter into the Knowledge of the hidden Secrets and Wonders of natural Things.

He has so clearly laid open, and set before our Eyes, the most beautiful Frame of the System of the World, that, if King *Alphonfus* were now alive, he would not complain for want of the Graces, either of Simplicity, or of Harmony in it. We may now more nearly behold the Beauties of Nature, and entertain ourselves with the delightful Contemplation ; and, which is the best and most valuable Fruit of Philosophy, be thence incited the more profoundly to reverence and adore the Great MAKER and LORD of All. He must be blind, who, from the most wise and excellent Contrivances of Things, cannot see the infinite Wisdom and Goodness of their Almighty Creator ; and he must be mad and senseless, who refuses to acknowledge them.



ANSWERS to the last ÆNIGMAS.

- | | |
|----------------------|---------------------|
| 1. A Pair of Glovea. | 4. The Letter S. |
| 2. Marriage. | 5. A Brick Chimney. |
| 3. State Lotteries. | |

I. Ænigma. *Answered by ----*

AS in soft Whisper with my Love
 I rudely once was told,
 We were as great as HAND and GLOVE,
 She blush'd, but could not scold.
 Don't mind the Clown, said I, my Dear ;
 He envies me the Blifs ;
 'Cause from you, napping, I a Pair
 Just got by stolen Kifs.

II. Ænigma. *Answered by J. H. M.*

THE Blessing of a prudent virtuous Wife
 Enhances every Sweet of human Life ;
 And it alleviates each afflictive Yoke,
 Where sympathizing Love divides the Stroke :
 But if our Lot should be the quite Reverse,
 Such MARRIAGE may be truly stil'd a Curse.

III. Ænigma. *Answered by J. T.*

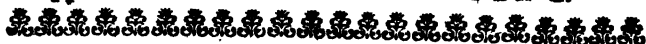
IN *WILLIAM's Reign, (if I guess right,) * [the 3d,]
 STATE LOTTERIES first saw the Light ;
 In this our Land : Whose Flatt'ring Look
 Both with the High and Low Church took.
 Such as were favour'd with a Prize,
 Extoll'd kind Fortune to the Skies :
 But some, whose Tickets came up Blanks,
 Vented their Grief in raging Pranks :
 Thus by the Hints which you disclos'd,
 I think the Riddle I've expos'd.

IV. Ænigma. *Answered by the same.*

WHAT Pity ! that his Name should lie conceal'd,
 Who to Mankind the useful Art reveal'd,

How

How, to make known th' Ideas of the Mind,
By Characters in various Order join'd :
CADMUS (if we rely on antient Story)
Of this admir'd Invention claims the Glory :
Whilst other Authors confident declare
That near the Time of the fam'd Trojan War,
Ingenious PALAMÉDES laid the Plan,
From whence Improvements of this Kind began :
Some have affirm'd, that long before the Flood
Mankind the Use of Letters understood :
But others, upon better Grounds believe,
That MOSES the first Pattern did receive ;
When, upon Sinai's Mount, the LAW was giv'n,
And wrote by the immediate Hand of Heav'n.
In this Ænigma Metaphors there be,
Which unto Letters generally agree ;
But that, which you disguise with artful Dress,
Appears to me to be the LETTER S.



Answers to the last PARADOXES.

I. Paradox. *Answered by J. H. M.*

TWO WIDOW LADIES married were,
Each to the other's Son ;
And they both pregnant did appear,
E'er one full Year was run.
The Consequence of which did prove,
To each a charming Boy ;
This did cement their Husband's Love,
And added to their Joy.
By this Event likewise its plain
They did commence Grandmothers,
And that their Husbands did obtain
Two young delightful Brothers.
A Brother you may justly call
Each, to the others Father :
Uncles they were reciprocal,
You easily may gather.

Paradoxes the 2d. and 3d. Answered by the same.

THE two short Paradoxes that remain,
I shall with equal Brevity explain :
The first, is WATER, rais'd by Man's Device.
O'er British Mountains, and the last is ICE. A

A P O E M

Advice to EURYALUS on his coming to Age.

SHINE bright, O SON! and doubly guild the Morn,
 On which the fair EURYALUS was born ;
 May no dark Cloud obscure thy cheerful Ray,
 Clear as his Soul, and as his Person gay ;
 And thou, dear Youth, with wonted Smiles attend
 The timely Counsel of thy faithful Friend.
 To Heav'n, as Right demands devote thy Bloom,
 Like hallow'd Incense with a rich Perfume.
 To no trait Man a blind Obedience pay,
 But let sage Reason's Voice thy Judgement sway.
 As Justice wills, allow to all their due ;
 And to thy Word, tho' Int'rest frowns, be true.
 The Poor unask'd with ready Hand relieve,
 And Cordial Counsel to th' Afflicted give.
 With Manly Fortitude thy Breast prepare
 The roughest Storms of checquer'd Life to bear :
 Let clear-ey'd Prudence thy whole Conduct guide ;
 Humble, not mean ; and sprightly, without Pride.
 Tho' warm thy Heart, yet lawless Fires controul :
 Temp'rance will lengthen Life, and cheer the Soul.
 Thy watchful Sword with dauntless Courage draw
 In the Defence of Liberty and Law.
 Quick beat thy Pulse, and glow each loyal Vein,
 To assert indulgent GEORGE's rightful Reign :
 Firmly to Honour's strictest Rules adhere ;
 Fearless, not vain ; tho' complaisant, sincere.
 Gaming, the Bane of many, shun ; nor play
 For more than you would freely give away.
 With few the Secrets of thy Bosom share,
 And chuse thy Friends with most deliberate Care :
 But when their Faith and Merit thou hast try'd,
 Let no new Scenes these Sacred Bonds divide.
 Be wisely slow in changing thy Estate ;
 With Caution act, and with mature Debate :
 Nor let the Charms of Wit, or wily Eyes,
 Unwarily thy gen'rous Soul surprize.
 Fix on a Nymph, whom milder Virtues grace,
 And sprightly Sense prefer above a Face.

Aim to promote the Welfare of Mankind :
 Life is a Gift for Publick Good design'd.
 Thus shall no Blot thy Reputation stain,
 But the whole Man immortal Joy shall gain.

As I have some spare Room in this Book, have taken the Liberry to insert the foregoing Poem, which well deserves to see the Light ; and since I have introduc'd this, I shall for the Future reserve a few Pages for such Poetical Essays, as any of my Readers shall see fit, to favour me withal. I always have look'd upon any Attempt to season the Minds of Youth, with the Principles of true Honour and Virtue, to be of singular Advantage to Mankind, that being a Part of Life too generally addicted to the eager Pursuit of Pleasure, to the Neglect of what is more worthy our Choice and Esteem : So that many have the greatest Reason to say, as EVANDER did in another Case :

O mibi præteritos referat si Jupiter Annos.

Virg. Æneid. Lib. 8.

The first Question answered by W. H.

Suppose the Star in the Pole of the Ecliptic at C, (as in Figure the first); then in the Triangle ACx there is given $Ax = 80,000,000$. Or $\approx$ to 1. and the Angle

$\angle CA = 23 \frac{1}{2}$ to find A C.

As the Nat. Sine of $23 \frac{1}{2}$: ——— :	11. 3936
Is to Ax Unity ——— :	I.
So is Radius ——— :	100000.
To A C equal to ——— :	8777.

Which are so many Semi-Diameters of the *Orbis Magnus*, each equal to 80,000,000 Miles. So that from the nearest of the fixed Stars to us is about 702,160,000,000. Miles : An almost inconceivable Distance. And hence the Time Light would be in passing from thence to us, is nearly

$d \ b \ . \ . \ .$
 $43 : 4 : 10 : 25$; and a Cannon Ball would be in running
 C over

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over the same Space, (at 13 Miles a Minute) $37508547 \frac{d}{b} : 0 : 12$ which is above 100000. Years.

Question the 2d. answered by R. P.

Put $y = A^h$ Number of Crowns } $b = 666$
 $x = B^h$ Number ——— } $c = 95$.

Then by the Question $\begin{cases} yx + b = y^3; \\ \text{and } y^2 + x^2 - c = 5x; \end{cases}$

By the first Step $x = \frac{y^3 - b}{y}$ and $x^2 = \frac{y^6 - 2by^3 + bb}{yy}$

Substitute in the second Step for x and xx their Value ;
then $y^2 + \frac{y^6 - 2by^3 + b^2}{yy} - c = \frac{5y^3 - 5b}{y}$ And by
Reduction and Transposition we have this Equation
 $\rightarrow y^6 + 4y^4 + 2by^3 + cy^2 - 5by = bb$. Hence $y = 9$,
and $x = 7$. Q. E. J.

Question the 3d. answered by Mr. B.

Suppose the two Numbers to be x and y , then by the
Question $xy^3 = (a \text{ perfect Square, which let be}) z^2 : \text{and } x = \frac{z^2}{y^3}$. Now for z^2 any Square may be assumed
that is divisible by y^3 , viz. put $z = 8, y = 2$. Then is
 $x = \frac{64}{8} = 8$. But $8 \times 2 \times 2 \times 2$, is a perfect Square as
required. This is one of those kind of Questions called
Diophantus's, or indeterminate, being capable of an in-
definite Number of true Answers.

Question the 4th. answered by J. T.

Draw the Lines as in the Scheme (*Fig. 2d*) and the
three Sides of the Triangle being given; find the Per-
pendicular By , and the Segments of the Base. Put
 $AC = 67 = 2a$; $Ay = 24.6 = c$; $Cy = 42.4 = d$.
 $By = 56.9 = b$; $Aw = x$; $Cv = y$. Then will $wv =$
 $x + y - 2a$. Now because the Triangle ADw is by the
Question to be equal to half the Triangle ABC , $= \frac{1}{2} ab$;
Therefore $DP = \frac{ab}{x}$. And for the same Reason $EK = \frac{ab}{y}$.
And

And the similar Triangles CBy, CEK, and AB γ , ADP give these Proportions. First, As $b : \frac{ab}{y} :: d : \frac{ad}{y} = CK$;

and $Ky = \frac{dy-ad}{y}$. Again $b : \frac{ab}{x} :: c : \frac{ac}{x} = AP$; and

$Py = \frac{cx-ac}{x}$. Hence also $Kv = \frac{y^2-ad}{y}$ and $wP =$

$\frac{x^2-ac}{x}$. Again the Triangles KEv, DwP, wSv, are all

similar, because the Angles at v and w, are common to all; and the Angles at S, K, and P, are right therefore:

$EK \left(\frac{ab}{y} \right) : Kv \left(\frac{y^2-ad}{y} \right) :: Pw \left(\frac{x^2-ac}{x} \right) : PD$

$\left(\frac{ab}{x} \right)$. And by multiplying Extreams and Means, we

have $x^2 y^2 - acy^2 - adx^2 + a^2 cd = a^2 b^2$. and $y^2 =$

$\frac{a^2 b^2 + adx^2 - a^2 cd}{x^2 - ac}$. In the next Place $wv(x+y-2a)$

$: wA(x) :: wSv \left(\frac{ab}{4} \right) : \frac{abx}{4x+4y-8a} = wSA$ Per 1st

Prop. 61^b. Lib. Eu c. From $wDA = \frac{ab}{2}$, subtract wSA,

there remains the Area of the Triangle ASD =

$\frac{abx + 2aby - 4a^2 b}{4x + 4y - 8a}$. Furthermore As AP : Py :: AD

: DB. and as AD : DB :: ASD : DSB. Consequently

as $AP \left(\frac{ac}{x} \right) : Py \left(\frac{cx-ac}{x} \right) :: ASD \left(\frac{abx + 2aby - 4a^2 b}{4x + 4y - 8a} \right)$

: DSB = $\frac{bx^2 - 5abx + 2bxy - 2aby + 4a^2 b}{4x + 4y - 8a}$. Likewise as

$wv(x+y-2a) : Cv(y) :: vSw \left(\frac{ab}{4} \right) : vSC =$

$\frac{aby}{4x + 4y - 8a}$. From $vEC = \frac{ab}{2}$, subtract vSC, and

there remains the Area of the Triangle CSE =

$\frac{aby + 2abx - 4a^2 b}{4x + 4y - 8a}$. But as CK : Ky :: CE : EB.

and as CE : EB :: CSE : ESB, Ergo as CK $\left(\frac{ad}{y} \right)$

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$$: Ky \frac{(dy - ad)}{y} :: CSE \frac{(aby + 2abx - 4a^2b)}{4x + 4y - 8a} : ESB =$$

$\frac{by^2 + 2bxy - 5aby - 2abx + 4a^2b}{4x + 4y - 8a}$. Now the Triangle ESB, more the Triangle DSB is equal to the Quadrilateral Figure DSEB = $\frac{1}{4}$ Part of the whole Triangle = $\frac{ab}{4}$. viz.

$$\frac{ab}{4} = bx^2 - 5abx + 2bxy - 2aby + 4a^2b + by^2 + 2bxy - 5aby - 2abx + 4a^2b, \text{ divided by } 4x + 4y - 8a, \text{ which reduc'd and transpos'd is } x^2 - 8ax + 10a^2 + y^2 = 8ay - 4xy. \text{ Substitute for } y^2 \text{ and } y, \text{ their Values before found: And } x^2 - 8ax + 10a^2 + \frac{a^2b^2 + adx^2 - a^2cd}{x^2 - ac},$$

$$= 8a - 4x \sqrt{\frac{a^2b^2 + adx^2 - a^2cd}{x^2 - ac}}. \text{ This reduc'd to one Denomination, and } 8a - 4x, \text{ brought under the Root, gives } x^4 - 8ax^3 + 10a^2x^2 - acx^2 + 8a^2cx - 10a^3c + a^2b^2 + adx^2 - a^2cd, \text{ divided by } x^2 - ac. = \sqrt{16a^2b^2x^2 + 16adx^4 - 16a^2cdx^2 - 64a^3b^2x - 64a^2dx^3 + 64a^3cdx + 64a^4b^2 + 64a^3dx^2 - 64a^4cd}, \text{ divided by } x^2 - ac; \text{ For the known Co-efficients of } x \text{ and its Powers put Letters, and } x^4 - fx^3 + gx^2 + hx - k = \sqrt{mx^4 - nx^3 + px^2 - qx + r}$$

Square the Numerator of the first Part of the Equation, and take away the Radical Sign of the 2d Part, and multiply it by $x^2 - ac$, and transpose the Terms, will give this Equation of the 8th. Power.

$$\begin{aligned} & -x^8 + 2fx^7 \left. \begin{array}{l} +m \\ -2g \\ -ff \end{array} \right\} x^6 \left. \begin{array}{l} +2fg \\ -2b \\ -n \end{array} \right\} x^5 \left. \begin{array}{l} +2k \\ +2fb \\ -gg \end{array} \right\} x^4 \left. \begin{array}{l} +acn \\ -q \\ -2gb \end{array} \right\} x^3 \\ & \qquad \qquad \qquad -acm \left. \begin{array}{l} +2gk \\ +r \\ -kb \\ -acp \end{array} \right\} x^2 \left. \begin{array}{l} +acq \\ +2bk \end{array} \right\} x = \left. \begin{array}{l} +kk \\ +acr \end{array} \right\} \end{aligned}$$

ANSWERS to the last Arithmetical Questions. 15

In Numbers $-v^8 + 536.x^7 - 70350.x^6 + 2208588.x^5 + 141731084.x^4 - 11101565353.x^3 + 155776050139.x^2 + 7348869315871.x = 191821297287673$. and by converging Series x is found $= 63.2$, hence $y = 50.6$ Now x and y being found, and consequently $wv = x + y - 2a = 46.8 = n$, and the Area of the Triangle $wSv = ab = 476.5 = p$; put $wS = x$, $vS = y$; then $\frac{x^2}{p} = \frac{y^2}{p}$ and $x^2 + y^2 = n^2$: But $x = \frac{2p}{y}$ and $x^2 = \frac{4p^2}{y^2}$.

Ergo $\frac{4p^2}{y^2} + y^2 = n^2$; $y = \sqrt{\frac{1}{4}n^2} - \sqrt{\frac{1}{4}n^4 - 4pp}$
 $= 23.6$, and $x = 40.4$; and the several Fences are,

Viz. $Av = 16.4$	}	$vw = 46.8$	}	$SE = 20.4$
$vS = 23.6$		$Sw = 40.4$		$EB = 23.5$
$SD = 18.0$		$Cw = 3.8$		$BD = 29.9$
$DA = 32.1$		$CE = 47.5$		

Question the 5th answered by J. F.

Put (in Figure the 3d.)

$AB = 50 = 2b$; } The Area $p q s$ is $= x + z \times d^3 y$,
 $CD = 30 = 2c$; } the Triangle $q s w = x + z \times d^3 y$
 $pm = x$, $ms = z$, } consequently the whole Area $p q w s n p$
 $ns = 3y$, $pw = 5y$. } $= x + z \times d^3 4y$.

By the Property of the Ellipsis we have

As $b^2 : c^2 :: b^2 - z^2 : 9y^2$, hence $z = \sqrt{c^2 b^2 - 9b^2 y^2}$

and $b^2 : c^2 :: b^2 - x^2 : 25y^2$ and $x = \sqrt{c^2 b^2 - 25b^2 y^2}$

Therefore $4y \sqrt{c^2 b^2 - 9b^2 y^2} + 4y \sqrt{c^2 b^2 - 25b^2 y^2}$

must be a MAXIMUM. — This in FLUXIONS is

$\frac{32c^2 b^2 y y - 576b^2 y^3 y}{2\sqrt{16c^2 b^2 y^2 - 144b^2 y^4}} + \frac{32c^2 b^2 y y - 1600b^2 y^3 y}{2\sqrt{16c^2 b^2 y^2 - 400b^2 y^4}} = 0$

divide by y and transpose one of the Terms, and then involve both Sides, and by multiplying crossways we shall have an Equation of the 10th Power, which being divided by $b^6 y^6$ and transposed, will give this following, quadratick Equation, viz.

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$$14400 y^4 - 2176 c^2 y^2 + 48 c^4 = \left\{ \pm \frac{c^2}{y} \right\} = 0$$

in Numbers $y^4 = 34$. $y^2 = 168.75$ and by completing the SQUARE and extracting the ROOT,

$$y \sqrt{17.} - \sqrt{120.25} = 2.461 \text{ and by this}$$

$x = 14$, 4 , $z = 21.8$, $3y = 7.38$, $5y = 12.30$ and hence the four Sides of the Trapezoid are $wy = 24.6$; $st = 14.76$; $ws = yt = 36.53$ and its Area = 712.416 Square Feet, *Q. E. I.*

Question the 6th answered by I. T.

In the first Place from the Area of the Circle given, we must find its Diameter which is $= \frac{\sqrt{3848.46}}{.7854}$ (as is demonstrated in most Mathematical Treatises) $= 70$. Feet, (*see Figure the 4th*) then in the Triangle AxC , we have given $Ax = Cx = 35$. and $AC = 62$. to find the perpendicular $xx = 16.3$ (for xs and xm are supposed to be perpendicular to AC , BD .) also in the Triangle BxD , we have $Bx = Dx = 35$. and $BD = 64$. to find $xm = 14.2$; but the Angle $mxs =$ Complement of AnD to $180^\circ = 76^\circ : 6$ because the Angles at s and m , are right, and all the Angles of the Quadrilateral $Snmw$, are equal to four right Angles; so in the Triangle mxs are given the two Sides xm , xs , and the contained Angle mxs , to find $ms = 18.8$, and the Angles msx , $smx = 46^\circ : 58'$ and $57^\circ : 62'$, and subtracting each of them from 90° : — we have in the Triangle mns all the Angles and the Side ms to find $mn = 13.3$ and $sn = 10.6$: Lastly $AS = \frac{1}{2} AC = 31$. and $Bm = \frac{1}{2} BD = 32.0$ the Triangles AxC , BxD being *Isoceles*, *Ergo*, $As + sn = An = 41.6$ and $Bm - mn = Bn = 18.7$ and now we have in the four Triangles made by the four Sides of the Trapezium, two Sides and a contained Angle in each, to find the said four Sides, which are, *viz.* $AB = 41.3$, $BC = 30.8$; $CD = 45$.; $DA = 68.5$;

Question the 7th answered by R. F.

Here is given first the Latitude sailed from $54^\circ : 8$, and the Ship's Departure 44.45 Miles; and her Difference of Longitude 74.17 Miles (*vide Figure the 5th*) Put $x =$ Length of the Arch of the Latitude arriv'd in, then

ANSWERS to the last Arithmetical Questions. 17

then (as Dr. Halley has demonstrated in *Phil. Transactions*, Vol. I.) the meridional Parts belonging that Latitude will be $= \frac{1}{a}$ into $x + \frac{1}{2}x^3 + \frac{1}{24}x^5 + \frac{1}{120}x^7$

$+ \frac{1}{720}x^9$ &c. (where a is equal to the Length of the Arch of 1 Minute $= .00029088$) consequently $\frac{1}{a}$

$= 3438$. fere. And now to make all the Parts of the Triangle alike, we will instead of dividing the above Series by a , multiply B C and D E, &c. by a . Put $44.45 \times^d a = c = BC$; $74.17 \times^d a = d = DE$; and $54 \times^d 60 \times^d a = b$; $n = 3864$. the Meridional Parts for the Latitude of $54^d: 60$. Then is $n - x - \frac{1}{2}x^3 - \frac{1}{24}x^5 - \frac{1}{120}x^7 - \frac{1}{720}x^9$, &c. $= AE$ the Meridional Difference of Latitude; but the proper Difference of Latitude AB is $= b - x$. Now as (AB) $b - x$: (BC) c $\therefore$ (AE) $n - x - \frac{1}{2}x^3 - \frac{1}{24}x^5$, &c. : (ED) d .

and multiplying Extreams and Means we have $\frac{bd - dx}{c}$
 $= n - x - \frac{1}{2}x^3 - \frac{1}{24}x^5 - \frac{1}{120}x^7 - \frac{1}{720}x^9$ &c.
 put $\frac{bd}{c} = m$; $-\frac{d}{c} = -p$; and $m - px = n - x - \frac{1}{2}x^3$, &c.

and by Transposition $n - m = 1 - px + \frac{1}{2}x^3 + \frac{1}{24}x^5 + \frac{1}{120}x^7$
 put $n - m = q$; $1 - p = f$; and substitute Letters for the known Co-efficients of the Powers of x . Then $fx + rx^3 + sx^5 + tx^7 + gx^9$, &c. $= q$. And by the

$$\text{Method of Reversion of Series } x = \frac{q}{f} - \frac{rq^3}{f^4} + \frac{3r^2 - fs}{f^7} q^5 \\ + \frac{8frs - f^2t - 12r^3}{f^{10}} q^7 + \\ + \frac{55r^4 - 55fr^2s + 10f^2rs + 5f^2s^2 - f^3g}{f^{13}} q^9,$$

&c. $= .9231$, but x , or the Length of the Arch being known, the Latitude in Degrees corresponding thereto, will be easily found by saying, As $1.5708 : 90^d :: .9231 : 52^d.89$, the Number of Degrees it contains $= 52^d.53\frac{1}{2}$ The Latitude arrived in. The other Case wherein one Latitude, Distance, and Difference of Longitude are given,

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given, must be wrought exactly after this Manner only when you come to make the Proportion $A B : B C :: A E : E D$. because $B C$ is not directly given it must be found by the 4th 1 *Eucl. viz.* $\sqrt{A C^2 - A B^2} = B C$

and $b - x : \sqrt{c^2 - b^2 + 2bx - x^2} :: n - x - \frac{1}{6}x^3 - \frac{1}{24}x^5$
Esc. : d And

$$\frac{db - dx}{\sqrt{c^2 - b^2 + 2bx - x^2}} = n - x - \frac{1}{6}x^3 - \frac{1}{24}x^5$$

$-\frac{1}{24}x^7$, *Esc.* Now in this Case there will be a little more Difficulty than in the former, because both Sides of the Equation must be squared; the chief Trouble being in raising the 2^d Part of the Equation, which is an infinitonomial to the Second Power.

Question the 8th, answered by I. T.

In Figure the 6th there is given $BS = 20. = c$; $DG = 22 = d$; $HF = 16. = b$; put $CH = y$; $AF = x$; $AH = x - b$. then by similar Triangles, As $x - b : y :: c : \frac{cy}{x - b} = CS$. consequently $HS = y - \frac{cy}{x - b}$

and $y : b :: d : \frac{bd}{y} = GF$. Ergo $GH = SN = b - \frac{bd}{y}$

$DN = d - y + \frac{cy}{x - b}$. But $\frac{yx}{2} =$ Area of the Triangle

ACF ; As $y : b :: \frac{cy}{x - b} : \frac{bcy}{xy - by} = SE$, hence $BE = c + \frac{bcy}{xy - by}$. But $c + \frac{bcy}{xy - by} \times d \frac{cy}{2x - 2b} = \frac{yx}{4}$ by

the Question, that is, $\frac{c^2 y^2 x}{2yx^2 - 4byx + 2b^2 y} = \frac{yx}{4}$ multiply cross-ways and transpose the Terms, and divide all by $2y^2x$ and $x^2 - 2bx = 2c^2 - b^2$ and extracting the Root $x = \sqrt{2cc + b} = 44.3$ and now x being known,

put $x - b = n$, and then $DN = \frac{nd - ny + cy}{n}$; and

$SN = \frac{by - bd}{y}$, $SH = \frac{ny - cy}{n}$ The Triangles SDN ,
LSH

L S H are similar, hence $DN : SN :: SH : LH$, and $LH + HG = LG$ and $\sqrt{LG^2 + DG^2} = a$ MINIMUM by the Question. As $\frac{nd - ny + cy}{n} : \frac{by - bd}{y} :: \frac{ny - cy}{n}$

$$: \frac{nby^2 - ndby - cby^2 + cdb y}{ndy - ny^2 + cy^2}; \text{ put } m = nb - cb; s = -ndb + cdb; nd = q; -p = -n + c; \text{ and divide both the Numerator and Denominator of the above Fraction by } y.$$

Then $LH = \frac{my - s}{q - py}$, Consequently $LG = \frac{my - s}{q - py} + \frac{by - bd}{y}; = \frac{my^2 - sy + bqy - bdq - bpy^2 + bdp y}{qy - py^2}$.

But $m - bp = 0$, Ergo sy vanishes.

Put $r = bq + bdp - s$; and $-t = -bdq$.

Then $\frac{ry - t}{qy - py^2} = LG$. and $\sqrt{\frac{r^2 y^2 - 2rty + t^2}{p^2 y^4 - 2pqy^3 + q^2 y^2}} + dd$

Equal in Fluxions to Nothing. This its evident when thrown into Fluxions, and divided by yy will produce an Equation of the 6th Power, wherein the Value of y will be found $= 40.8$ and hence the Sides of the Triangle, viz. $AF = 44.3$ $CF = 43.9$ $CA = 49.7$ The Triangle LFD will also be Ifofceles, the Sides FD, FL being each $= 23.7$ and $DL = 26.7$.

Question the 9th, answered by J. C.

Here is given in the Triangle Pxy (Fig. 7th)

$Px = 74 : 18$ the Co-declination of Aldebaran, and

$Py = 51 : 28$ the Co-declination of the Comet, and

$xy = 50 : 37$ the Difference of their setting Amplitudes to find the Angle Pyx. The Cannon is this.

As the Rectangle of the Sines of xy . Py . 19.78147 is to the Square of Radius ——— 20.

Sq is the Rectangle under the two Excesses of half the Sum of the three Sides above each of the two Sides Py and xy . } 19.56171

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To the Square of the Sine of half the $\left. \begin{array}{l} \text{Angle } Pyx. \\ \text{Angle } Pyx. \end{array} \right\} 19.78023$

The half of this is 9.89011 which is the Sine of 50^d ; 57

so the Angle $Pyx = 101^d$; 54.

Again in the right Angled Triangle POy there is given

$Py = 51^d$; 28, and the Angle $PyO = 78^d$; 6 to find PO .

As Radius $\frac{10.00000}{10.00000}$

is to the Sine of Py , 51^d ; 28 $\frac{9.89334}{9.89334}$

So is the Sine of the Angle PyO 78^d ; 6 $\frac{9.99056}{9.99056}$

To the Sine of PO 49^d ; 56 $\frac{9.88390}{9.88390}$

which is the Latitude of the Place where the Observation was made. *Q. E. F.*

Question the 10th answered by R. F.

(In Figure the Eighth) There is given

$AB = 30. = c$, } Let $CP = x$; $BP = a - x$;

$QC = 60. = b$, } and draw GH perpendicular to BC ;

$BC = 40. = a$, } and $\frac{ba - bx + cx}{b}$ An Parallel to BC ;

As $b : x :: c : \frac{cx}{b} = PH$; but $AG = \frac{ba - bx + cx}{b}$;

and $AP = \sqrt{c^2 + a^2 - 2ax + x^2}$ and $QP = \sqrt{b^2 + x^2}$;

As $\sqrt{b^2 + x^2} : 1 :: b : \sqrt{b^2 + x^2} = \text{Sine } \angle QPC$
 $= \angle QGn = \angle AGP$.

As $\sqrt{c^2 + a^2 - 2ax + x^2} (AP) : \sqrt{b^2 + x^2} (\angle AGP) ::$
 $\frac{ba - bx + cx}{b} AG : S, \angle APG = \frac{ba - bx + cx \times \sqrt{b^2 + x^2}}{b \sqrt{c^2 + a^2 - 2ax + x^2}}$

which by the Import of the Question must be a Maximum, and consequently the Fluxion of it equal to 0,
 Put $d = \frac{b}{c} + \frac{a}{c}$, and the above when reduced will be

$$\frac{\sqrt{b^4 a^2 - 2b^3 a x + b^2 a^2 x^2 + b^2 a^2 x^2 - 2b d a x^3 + d^2 x^4}}{b^4 c^2 + b^4 a^2 - 2b^4 a x + b^4 x^2}$$

or putting other Letters for the known Quantities

$$\sqrt{m - nx + px^2 - qx^3 + rx^4} = \text{Sine of the } \angle APG$$

The Fluxion of this is, $4rx^3x' - 3qx^2x' + 2pxx' - nx'$
 $x^d f x^2 - tx + s$. Subtracting from it, $2fx'x - tx'x^d$ By
 $rx^4 - qx^3 + px^2 - nx + m$. This it is evident will
 give an Equation of the 5th Power, wherein the Value
 of x is found by converging Series to be equal to 9.22
 Yards, *quam proxime*.

In the next Place for the Geometrical Construction,
 join AQ and bisect it in w , and erect the Perpendicular
 wy , and produce it till it meet the Line BC (produced
 if need be) in F; then describe a Circle which shall
 pass through the Points A, Q, and touch the Line BC
 as in P, I say P is the Point sought.

DEMONSTRATION.

Since no Segment of a Circle less than the above can
 be described upon AQ so as ever to meet with the
 Line BC; and if it be a greater Segment the Angle
 will be more diminished, *per 31 Prop. 3^d Euc.* therefore
 the Angle APQ is the greatest that can be describ'd
 upon AQ, whose angular Point is situate in the Line
 BC. From hence results a very easy Calculation; for
 the Angle QSw is = Angle QAn which is known,
 as also Qw, find QS and wS; from QC subtract
 QS remains SC; and the vertical Angles being equal
 find FS and FC. But FS + wS = Fw which call
 b ; Qw = C, wy = z, Fy = $b - z$; Nat. sine of the
 Angle PFy = d , Radius = Unity. As $1 : b - z :: d$
 $: db - dz = Py$ and $\sqrt{cc + zz} = Qy$; But Qy = Py
 they being radii of the same Circle Ergo $\sqrt{cc + zz}$
 $= db - dz$. And by Involution and Transposition we
 have $1 - ddz^2 + 2d^2bz = d^2b^2 - c^2$. Put $\frac{2ddb}{1 - dd} = n$
 and $\frac{d^2b^2 - c^2}{1 - d^2} = q$, then $z^2 + nz = q$; and $z = \sqrt{q + \frac{1}{4}n^2}$
 $= \frac{1}{2}n = 18.1$. Lastly, As FS : FC :: Fy : FP. from
 which subtract FC remains CP = 9.22 and BP
 = 30.78.

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Question the 11th answered by I. F.

In the first Place let $b = 492916\frac{1}{2}$; $p = 1300$. the Parameter; $x = BG$ (Figure the 9th.) Then $PB = \frac{xx}{p}$ and the Area of the Triangle $PGB = \frac{x^3}{2p}$; But the Area of the Semi-parabola $PMGB = \frac{2x^3}{3p}$; Ergo the Segment $PMG = \frac{x^3}{6p} = \frac{2x^3}{3p} - \frac{x^3}{2p}$. and the Area of the Triangle $PSG = \frac{1}{2} p \times d \frac{1}{2} x = \frac{px}{8}$ consequently $\frac{x^3}{6p} + \frac{px}{8} = b$: and by converging Series x is found = 1300. also $PB = 1300$.

Now put $p = Lat. rect. = 1300$. $\left. \begin{array}{l} p = PB = ditto \\ x = Pq = PR \\ 2x = Rq, \\ p - x = Bq. \end{array} \right\} \begin{array}{l} Mg = \sqrt{px} \\ RB = p + x \\ RM = \sqrt{4x^2 + px} \\ BM = \sqrt{x^2 - px + p^2} \end{array}$

Then by Theorem the 5th, Pag. the 87th, Vol. II. of Ozanam

$$\frac{4x^2 + px + x^2 - px + p^2 - p^2 - 2px - x^2}{2\sqrt{4xx + px} \times d \sqrt{x^2 - px + pp}}$$

= Co-sine of the $\angle RMB = \frac{2xx - px}{\sqrt{4x^4 - 3px^3 + 3p^2x^2 + p^3x}}$

and $\sqrt{1 - \frac{-4x^4 + 4px^3 - p^2x^2}{4x^4 - 3px^3 + 3p^2x^2 + p^3x}} = \sin \angle RMB$
 $= \sqrt{\frac{px^2 + 2p^2x + p^3}{4x^3 - 3px^2 + 3p^2x + p^3}}$. This in Fluxions is
 $\frac{2pxx + 2p^2x \times d 4x^3 - 3px^2 + 3p^2x + p^3}{12x^2x - 6pxx + 3p^2x \times d px^2 + 2p^2x + p^3}$ Lets by

This reduced and divided by x must be made = 0, and will produce an Equation of the 4th Power wherein $x = 178.7$, and hence the angle $RMB = 103^d : 16' Q.E.I.$

Question

Question the 12th answered by I. T.

In Fig. 10th, put $y = \text{Nat. Sine of the Sun's Azimuth from the South, and also = to his Altitude}$; $b = \text{ZP} = 37^{\text{d}} : 00$ the Co-latitude, its Nat. Sine. 60181; $c = \text{P} = 71^{\text{d}} : 56$ the Co-declination, its Nat. Sine . 95070; $d = \text{Nat. versed Sine of the Difference of}$

the Sides $\text{Px, PZ} = 34^{\text{d}} : 56 \quad \left. \vphantom{\begin{matrix} \text{the Sides Px, PZ} \\ = 34^{\text{d}} : 56 \end{matrix}} \right\} . 18018$

Then is $\sqrt{1 - y^2} = \text{Zx}$, and $1 - y = \text{versed Sine of Zx}$. Now as $c : y :: \sqrt{1 - y^2} : \frac{\sqrt{y^2 - y^4}}{cc} = \text{Nat. Sine of the Angle ZPx by the 1st Axiom of Trigonometry}$.

But by Theorem 30th, Page the 120th, Vol. II. of *Ozanam*, As $bc : 1 :: 1 - y - d : \frac{1 - d - y}{bc} = \text{the nat. versed Sine of the Angle ZPx}$; consequently its Co-sine

$= 1 - \frac{1 + d + y}{bc} = \frac{bc - 1 + d + y}{bc}$ put $p = bc - 1$

$+ d$; Then $\frac{y - p}{bc} = \text{Co-sine}$, and $\frac{\sqrt{b^2 c^2 - y^2 + 2py - p^2}}{b^2 c^2} = \text{Nat. Sine of the Angle ZPx}$.

Ergo $\sqrt{\frac{y^2 - y^4}{c^2}} = \sqrt{\frac{b^2 c^2 - y^2 + 2py - p^2}{b^2 c^2}}$ Multiply the Numerator of the 1st Part of the Equation by b^2 and take away the Radical Sign, and transpose the Terms $-b^2 y^4 + 1 + b^2 y^2 - 2py = b^2 c^2 - p^2$. here $y = .7354$ the Nat. Sine of $47^{\text{d}} : 20$ the Sun's Altitude and Azimuth, and the Time of the Day is $2^{\text{h}} 4^{\text{m}}$ Afternoon.

Again in Figure 11th. Let S represent the Glass plac'd on the Floor at the Middle of the South Wall, and R the Top of the North-East Corner of the Room, and put $2y = \text{height of the Room} = \text{PR}$; $c = \text{End Area} = 80$.

Then the Breadth will be $= \frac{c}{2y} = \text{HB}$ in Figure 12.

$a = \text{Nat. Sine of the Angle RSP the Sun's Altitude}$; $b = \text{Co-sine} = \text{Angle PRS}$; Then

As $a : 2y :: b \frac{2by}{a} = \text{PS Fig. 11. Or} = \text{VB} = \text{VH Fig. 12}$.

But

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But the Azimuth being equal to the Altitude, that is, the Angle $BVn = RSP$; we have in Figure 12. this Proportion As $a : \frac{c}{4y} :: b : \frac{bc}{4ay} = Vn$ the Length of

the Room, and $Vn^2 + Bn^2 = Bv^2$.

i. e. $\frac{b^2 c^2}{16a^2 y^2} + \frac{c^2}{16y^2} = \frac{4b^2 y^2}{a^2}$; and by Reduction

$$y = \sqrt{\frac{bbcc + aacc}{64bb}} = \sqrt{\frac{c}{8b}} = 3.8310$$

because the Sine and Co-sine of an Angle are in Power = Unity. Hence the Height of the Room is 7.662 Feet, the Breadth = 10.44, the Length = 4.81;

This is supposing that by the End of the Room is meant the North Wall: But if the East or West Wall be understood thereby, then putting the same Letters as

before $BC = \frac{c}{2y}$; and As $b : \frac{c}{2y} :: a : VC = \frac{ac}{2by}$;

and $BV = \sqrt{BC^2 + VC^2} = \sqrt{\frac{a^2 c^2}{4b^2 y^2} + \frac{c^2}{4y^2}}$;

but $BV = PS$ Fig. 11th. Therefore as $a : (PR)$

$2y :: b : PS = \frac{2by}{a} = \sqrt{\frac{a^2 c^2}{4b^2 y^2} + \frac{c^2}{4y^2}}$;

or $\frac{4b^2 y^2}{a^2} = \frac{a^2 c^2}{4b^2 y^2} + \frac{c^2}{4y^2}$, $y = \sqrt{\frac{a^4 c^2 + a^2 b^2 c^2}{16b^4}}$

and in this Case $y = 5.7$ and hence the Room's Height = 11.4; Breadth = 7.02; Length = 15.24.

Question the 13th answered by R. F.

Let y = Number of Sheep, x = Number of Shepherdes, then per Question $\frac{y}{x} = 2x$, and $y = 2xx$. But in a Series of Geometrical Proportionals wherein the first Term is = 1; common Ratio = 2; last Term = y ;

Number of the Terms = x ; $1 \times 2^{x-1} = y$; Or $2xx$

= 2^{x-1} by putting for y its Equal $2xx$; now by the Nature

Nature of Logarithms, The Logarithm of the Power of any Number is equal to the Log. of the Root multiply'd by the Index of the Power : Suppose $6 + y = x$; and

the above Equation becomes (instead of $2xx = 2^{n-1}$)

$$2 \times 6 + y^2 = 2^{y+5} ; \text{ Or } 6 + y^2 = 2^{y+4} ; \text{ Now}$$

to find the Hyperbolical Logarithm of $6 + y$ we must

find the Fluent of $\frac{y}{6+y} = y \times d \frac{1}{6+y}$: This will be

$$y \times d \frac{1}{6} - \frac{y^2}{36} + \frac{y^3}{216} - \frac{y^4}{1296} + \frac{y^5}{7776} \text{ \&c. and to it add}$$

the Hyperbolical Log. of 6. = 1.791756 = m . The

$$\text{Fluent of this is } m + \frac{y}{6} - \frac{y^2}{72} + \frac{y^3}{648} - \frac{y^4}{5184} + \frac{y^5}{38880}$$

Put p = Hyperbolical Log. of 2. = .693146 Then by

$$\text{the above Rule } 2m + \frac{y}{3} - \frac{y^2}{36} + \frac{y^3}{324} - \frac{y^4}{2592} + \frac{y^5}{19440}$$

$$= py + 4p ; \text{ Let } 2m - 4p = q ; p - \frac{1}{3} = a ; \text{ and}$$

$$\text{transpose the Terms. Then } ay + \frac{y^2}{36} - \frac{y^3}{324} + \frac{y^4}{2592}$$

$$- \frac{y^5}{19440}, \text{ \&c.} = q, \text{ Or putting Letters for } \frac{1}{36}, \frac{1}{324}.$$

$$\frac{1}{2592}, \frac{1}{19440}, \text{ \&c. } ay + by^2 - cy^3 + dy^4 - fy^5, \text{ \&c.}$$

$$= q ; \text{ and by the Method of Reversion of Series, } y = \frac{q}{a}$$

$$- \frac{bq^2}{a^3} + \frac{2ab - ac}{a^5} q^3 - \frac{aad - 3b^2 + 5abc}{a^7} q^4, \text{ \&c.}$$

= when carried on to a sufficient Number of Places exactly to 2 ; consequently $x = 8$, the Number of Shepherdes, and the Number of Sheep is 128. Q.E.I.

Question the 14th answered by I T.

In all Curves whatsoever concave towards the Axis, the Value of the Subnormal is expressed by $\frac{yy}{x}$ which

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is thus demonstrated. (*In Figure the 13th,*) AB is the Subtangent, and BK is the SUBNORMAL, draw the Semi-ordinate bp infinitely near and Parallel to BP; then the very small Triangle Ppn may be looked upon as rectilinear, wherein Pn is the Fluxion of the Abscissa $SB (x) = \dot{x}$; and pn is the Fluxion of the Ordinate $BP (y) = \dot{y}$; but the Triangles Ppn , BPK are similar, (for the Angles at B and n are right, also the Angles BPn , KPp are right; now if we subtract from both the common Angle KPn , there remains the Angle $BPK = \text{Angle } n Pp$;) Therefore it will be As Pn

$(\dot{x}) : pn (\dot{y}) :: PB (y) : \frac{yy}{x} = BK$. but by the Quest-

tion $\frac{yy}{x} = a$; and $y\dot{y} = a\dot{x}$ and finding the Fluents

on both Sides we have $\frac{yy}{2} = ax$; or $2ax = yy$. Con-

sequently the Curve is the quadratick (or common) Parabola, wherein a is equal to half the Parameter.

E R R A T A.

Page the 16th, Line the 4th, for $y \sqrt{17. - \sqrt{120.25}}$;
read $y = \sqrt{17. - \sqrt{120.25}}$



New ENIGMAS to be answered.

(1.) ENIGMA the 6th, by J. H. M.

I Was in distant Northern Climates born ;
 Or rather from my Mother's Bowels torn ;
 Perhaps you'll say, it was a dismal Fate,
 My Being from her Death should take its Date ;
 Transported with great Hazard and Fatigue,
 To *British* Isles, I was in Marriage League
 Unto a Foreign Spouse so strictly ty'd,
 That mutual Death can only us divide ;
 And though a Couple scarcely e're was seen,
 More different in Complexion, Shape and Mien,
 We Strangers are to Matrimonial Jars ;
 Nor feel the Mis'ries of Domestick Wars :
 Incircled in each others Arms we lye,
 Emblems of truest Love and Constancy ;
 Great Trav'lers since our Union we have been,
 Have both the *West* and *Eastern Indies* seen,
 Expos'd to dire Extreams of Cold and Heat,
 Likewise to Dangers formidably great,
 Yet with unweary'd Strength and Patience bear
 The num'rous Toils allotted to our Care ;
 The Publick Good both Day and Night pursue,
 Without the Motive of a selfish View.
 But see ! how base Ingratitude prevails :
 When once our Usefulness and Vigour fails,
 All former Services seem quite forgot,
 And the most barb'rous Treatment proves our Lot ;
 Mangled and beat like Criminals, or Slaves,
 Whilst no kind Pity timely Help vouchsafes ;
 Yet faithful to each other still remain,
 Until resistless Fate unlinks our Marriage Chain.

(2.) ENIGMA the 7th, by Mr. J. B.

A Negro I, tho' sprung from Northern Climes,
 And like a Martyr die, for Merit, not for Crimes.
 Bury'd before I'm born, I rise to Light
 With mangled Limbs, no Hands, no Eyes for Sight,
 Yet fly my Country, but not safe in Flight :
 Hurry'd thro' Tempests, and thro' Waves convey'd,
 In Fair *Augusta's* Walls I seek for Aid :

E

There

There to her Gods I stately Temples raise,
 And court her Citizens a thousand Ways ;
 Visit each House, and wherefoe'er I go,
 So humble am, I all their Drudg'ry do.
 Yet neither Service, nor my Exile State,
 Can Pity move, nor screen me from their Hate ;
 Untimely Death I meet where e'er I come,
 Yet blest the Hands whence I receive my Doom :
 In Dungeon dark imprison'd first I lyé ;
 And then, like *Bajazet*, in Iron Cage, I dye.

(3.) ENIGMA the 8th, by ———

Long Time in Nature's Magazine I lay,
 Dormant, unactive like a Lump of Clay,
 'Till Heav'n did some aspiring Genius blest,
 With the true Knowledge of my Usefulness :
 And surely he, who first my Virtue found,
 Should with a lasting Memory be crown'd.
 'Tis by my Aid bold Mortals dare explore
 Those distant Climes they never saw before ;
 From whence a quick Return of joyful Gains,
 Rewards th' industrious Merchant's Care and Pains.
 Whilst *Virtuosos* justly me do prize,
 And rank me amongst Nature's Mysteries :
 The Ignorant are at my Power amaz'd,
 Perhaps supposing 'tis by Magick rais'd ;
 Trav'lers, who oft in strange Relations glory
 Of my great Strength, feign a romantick Story.
 Which by unthinking Persons is believ'd,
 And some, more wise, thereby have been deceiv'd.
 In my best Quality (I don't dissemble)
 The Ladies very nearly I resemble :
 And each of them that has a faithful Lover,
 My Name and Nature may with Ease discover.

(4.) ENIGMA the 9th, by J. H. M.

From Mankind chiefly I derive my Birth,
 And those, some of the greatest Rank and Worth ;
 But (tho' 'tis an Event not very common)
 I sometimes have receiv'd Life from a Woman.
 When once I am to full Perfection come,
 I straight the Marks of Sov'reignty assume :

My

My Parents jointly own my rightful Sway,
And my authoritative Voice obey ;
In hot Disputes I sit as Moderator,
And often prove a pow'rful Arbitrator :
By my decisive Sentence close a Peace,
And long oppressed Innocence release.
If any dare my just Commands dispute,
Their thoughtless Arrogance I'll soon confute :
In vain with me the rebel Crew contend ;
Experience shews, I conquer in the End.
But, tho' with Signs of Royalty surrounded,
My Pow'r's with certain Limitations bounded ;
And they who first my Lordly Being gave,
Can quickly send me to the silent Grave.

(5.) ENIGMA the 10th, by J. T.

I Am of modern Date I must confess,
But yet am valu'd for my Usefulness ;
Small tho' I be, Regard do justly claim
From the Fair Sex, whose Servant I became.
Sometimes in gay Attire I'm richly drest,
But when, by those of low Degree possess'd,
Am coarsely clad ; yet have such Charms about me,
That very few good Housewives are without me.
In different Forms and Magnitudes appear,
Tho' for the most part I'm Orbicular.
Hard is my Fate, you'll say, because that I
Am for my Usefulness hang'd commonly :
Nor only this, but pierc'd thro' ev'ry Pore
With Arrows keen till I can hold no more ;
Worn out, at last, I fall into Disgrace,
And to a new Successor yield my Place.
Ladies, pray show, since I your Servant am,
Not why you use me thus, but what's my Name.

New Mathem. Questions, to be Answered.

(1) Question the 15th, by I. T.

IN an oblique-angled plain Triangle, there is given
the Angle opposite to the base, or longest Side equal
to 107° : 00 ; and a Line drawn from the said angular
Point to the Middle of the Base, is known to be 27. Poles,
also the Angle which the said bisecting Line makes with
the

30 *New Mathematical Questions to be answered.*

the Base, is, $75^d : 00$, required to construct (and find the Sides of) the Triangle.

(2) *Question the 16th, by R. F.*

SUPPOSE the Radius of our Sphere
To be Four Thousand Miles, (.or near)
How high in Æther must I be,
Just so much of this Earth to see,
* That may, with what does not appear
Extream and mean Proportion bear.

(3.) *Question the 17th, by J. T.*

LET AB, CD (in Fig. 14) represent two Towers,
E a certain Point in the Line of Distance, its required
to solve the three following Cases by a Quadratic Equation
and also to construct them geometrically, and
lastly to find them by Trigonometry.

Case the 1st, given. $AE = 41$. Feet ; and $ED = 20$
Feet, and the Angle $BEC = 54^d : 00$ and $BE = EC$.

Case the 2d, given. $BA = 54$. $CD = 67$. $AD = 61$.
Feet, and the Angle $BEC = 49^d : 00$.

Case the 3d, given. $AE = 41$. $ED = 20$. Feet, and
the Angle $BEC = 44^d : 00$; and $AB = CD$, required
the several unknown Parts in each Case.

(4) *Question the 18th, by J. T.*

Iask'd my Friend what was the Time o' Day,
He straight reply'd, observe well what I say,
The Sun above our Horizon remains,
So long a Space as sixteen Hours contains :
Now if the Square Root of what Hours are past
* To the Cube Root of what are yet to waste,
Be Added ; then the Time without Dispute
You'll have, if from Sun-rising you compute.

(5.) *Question the 19th, by J. T.*

IT is required to find the Content of a Sphere, which
contains as many Ale Gallons, as there are Inches in
its Diameter.

* viz. That if from the Eye a Line be drawn to touch the
Earth's Superficies, and from the Point of Contact a Plain be let
fall perpendicular to the Axis, it may divide the solid Content
into extream and mean Ratio.

(6.) *Quest.*

New Mathematical Questions, to be answered. 31

(6.) *Question the 20th, by the same.*

LET it be required to find 3 Numbers, so that the first added to the Rectangle of the Second and Third may make 842. the Second added to the Rectangle of the First and Third may make 586. and the Third added to the Rectangle of the First and Second may make 458.

(7.) *Question the 21st, by R. F.*

IN *Theffaly* a tow'ring * Mountain stands,
From whence a View of all the neighb'ring Lands
Presents itself unto the naked Eye,
When e'er they're favour'd with a serene Sky ;
A Traveller exactly did contrive,
Upon its Top on *March* the Tenth t' arrive.
No sooner did the Sun's first Rays appear,
Than he to th' Plain his Course began to steer,
Proceeding on his Way with heedful Space,
And at the Foot he stood in two Hours Space ;
Which, from the Centre of th' abovesaid Hill,
He found to be the Distance of a Mile,
In a great Circle's Arch ; when again he
The Sun just peeping o'er the Mount did see.
You, who in Mathematick Arts delight,
Tell me exactly what's the Mountain's Height ;
I here † supposing the Observer's Eye
In the Horizon situate, or nigh ?

(8.) *Question the 22d, by Mr. J. B—dd—*

THE Air serene, walking on *Scarborough* Sand,
And having my supporting Staff in Hand,
A Project came into my Head to try,
Whether or no that Dinner Time was nigh ?
I set my Stick upright upon the Plain,
That so the Shade's true Length I might obtain ;
Which, having done, I found the same to be
Of a Hundred Parts exactly Sixty Three.
This being done the Twenty Ninth of *May*,
I hence demand the true Time of the Day ?
But one Thing more it's fit should be explain'd,
Sol had not yet his greatest Height attain'd.

* viz. Mount Olympus in the Latitude of 40° : North.

† Also setting aside Refraction and the Diameter of the Sun.

(9.) *Quest.*

32 *New Mathematical Questions to be answered.*

(9.) *Question the 23d, by J. T.*

A Gentleman, whilst walking in his Ground,
 A Stone of Shape and Size uncommon found ;
 Which, having with a curious Pleasure view'd,
 A strong Desire, to measure it, ensu'd :
 This by the Judgment of an Artist done,
 Its Form was found to be an upright Cone ;
 The slanting Side of which was eighteen Feet,
 The Base Diameter Fourteen compleat.
 He straight gave Orders that it should be sent
 Into his Garden for an Ornament ;
 Willing to have a Room made in the same,
 In one of these 3 Forms, which he should name :
 A Cube, a Cylinder, or Hemisphere,
 The greatest possible the Stone can bear.
 A skilful Artist has propos'd to cut
 The same, at twenty Pence the solid Foot :
 The Gentleman, all needless Charge to save,
 Some Mathematical Advice would have,
 By which he may with Satisfaction see,
 Which has the least Content of all the Three,
 That he may fix the Form accordingly :
 He likewise doth desire a just Account,
 To what it will in Sterling Coin amount ?

(10.) *Question the 24th, by J. N.*

EUCLID, in the 47th Proposition of his 1st Book of
 Elements, has demonstrated, That if, upon the three
 Sides of a right angled Triangle, three Squares be form-
 ed, that then the Square constituted upon the Hypothe-
 nuse $p q$, (Fig. 15th.) will be equal to the Sums of the
 Squares of the other two Sides, $G p$, $G q$. granting this,
 let the Lines AC , BE be drawn as in the said Scheme :
 I say, then the Triangle BqE is equal to the Triangle
 ACp . *Quere*, the Geometrical Demonstration.

(11.) *Question the 25th, by J. T.*

IT is required to find a Curve, the Semi-ordinate (y) of
 which is a mean Proportional between its Subtangent
 and $\frac{tp-2px}{t}$; where x is put universally for any Ab-
 scissa, and t and p are constant Quantities.

(12.) *Quest.*

(12.) *Question the 46th by R. F.*

L E T the Radius of a Circle be equal to the Length of a Pendulum which vibrates as many Times in a Minute, as it is Inches in Length, and in the said Circle its required to inscribe a Trapezium, whose four Sides, consequent to each other are in a Geometrical Progression whose common Ratio is 1.5 ; and likewise to inscribe a Trapezium, whose four Sides may be in Arithmetical Progression, whose common Difference is 20. required the Sides and Area of each, and the Diameter of the circumscribing Circle.

(13.) *Question the 27th by J. T.*

T I R'D with the Cares and Hurries of the Day,
One Evening to the Swan I took my Way ;

And there it was my Happinels to find
A Set of choice Companions to my Mind ;
With whom some Hours I pleasantly did pass
In useful Chat, sauc'd with a temp'rate Glass.

With Politicks, our selves we entertain'd
Until that Subject we had almost drain'd ;
Then Mathematicks our Discourse became,
A more extensive and improving Theme.

By Chance an Excise Officer came in,
Who b'ing sat down abruptly did begin,
And of his mighty Skill in gauging boasted,
Little suspecting how he wou'd be roasted :

One of the Company his Skill to prove,
For his Solution, did this Question move.

My Landlord's Copper being much decay'd,
Likewise too small for his increasing Trade ;

He made Enquiry all the Country round,
Until a noted Artist he had found ;

Whom, to make a new Copper, he imploy'd,
In Form of a Parabolic Conoid :

Yesterday Morn the Vessel home was sent
And finish'd to my Landlord's great Content ;
Who gladly would some Information gain,

What Quantity of Liquor 'twill contain ;
Said I, that may be known ev'n to a Hair,
If you its true Dimensions can declare.

All I can shew, (reply'd he) in this Case,
Is this, that the Circumference at the base,

To

34 *New Mathematical Questions to be answered.*

To wit, M, D, C, P, P, M, will be 2502.656
 The Inches which you in the Margin see. $\S$ (Fig. 16)
 And also if a Girt of it be made
 Over the Vortex, by a Line right laid;
 To wit, M, B, and C, you then will find
 The Measure that is by the same design'd,
 Inches One Hundred Seventy and Nine, 2
 To which Eight Tenths of an Inch you must join. $\S$ 179.8
 These several Hints observ'd, (you need not fear)
 To find its true Contents sufficient are
 Says the Exciseman (looking like a Woman)
 These *Data* in our Practice are not common:
 But to oblige you, Gentlemen, I'll try
 If your Enquiries I can satisfy.
 Away with Mind confus'd, the Gauger went,
 And several Days in poring on it spent;
 A Fortnight after, walking in the Street,
 With him I unexpectedly did meet;
 And thus address'd, Pray, Sir, have you discov'rd
 That Question, which was late to you propos'd?
 When he with an ingenuous, Condescension
 Did own, that it surpass'd his Comprehension
 (And so produc'd *Simonides* Excuse
 He made to *Hiero* King of *Syracuse*,)
 That the more he did in his Mind revolve it,
 He found himself less able to resolve it.
 You, who the Mathematick Arts profess,
 Pity an honest Soul in this Distress,
 And kindly help him to some Information,
 Whereby he may preserve his Reputation.

(14) *Question the 28th, by J. T.*

Given the Abscissa of the Parabola AEB (Fig. 17.) viz.
 $AC = 40$. and the Corresponding Semi-ordinate BC
 $= 30$. it is required to find the Locus of all the Points,
 as F, G, being such, that two Tangents as FD, FH; or
 GE, GI, to the Parabola being drawn from them; the
 Angles DEH, or EGI, contained by these Tangents,
 may be always equal to a right Angle.



F I N I S.

Fig 16

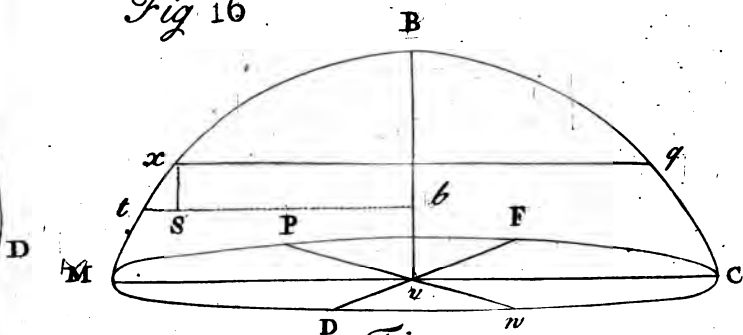


Fig.15

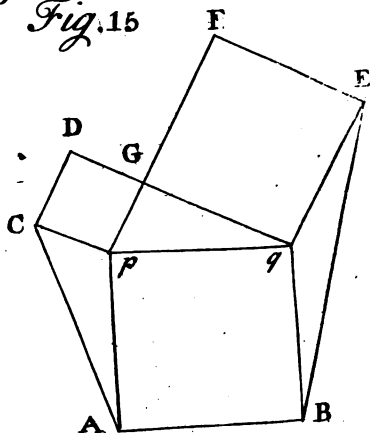


Fig.14

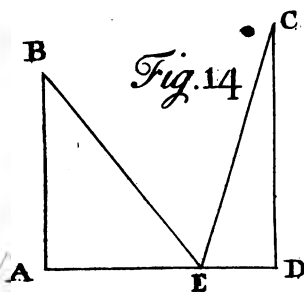
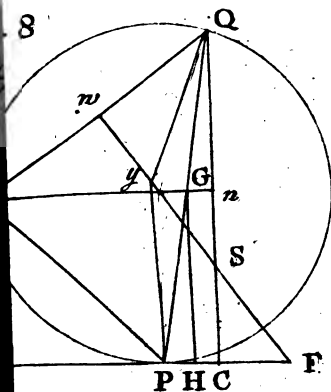
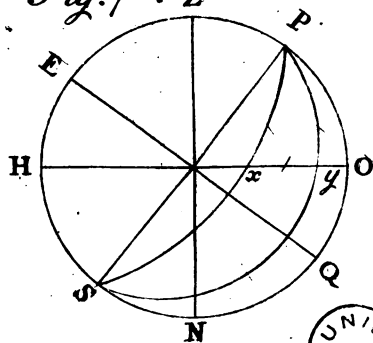


Fig.7 . Z



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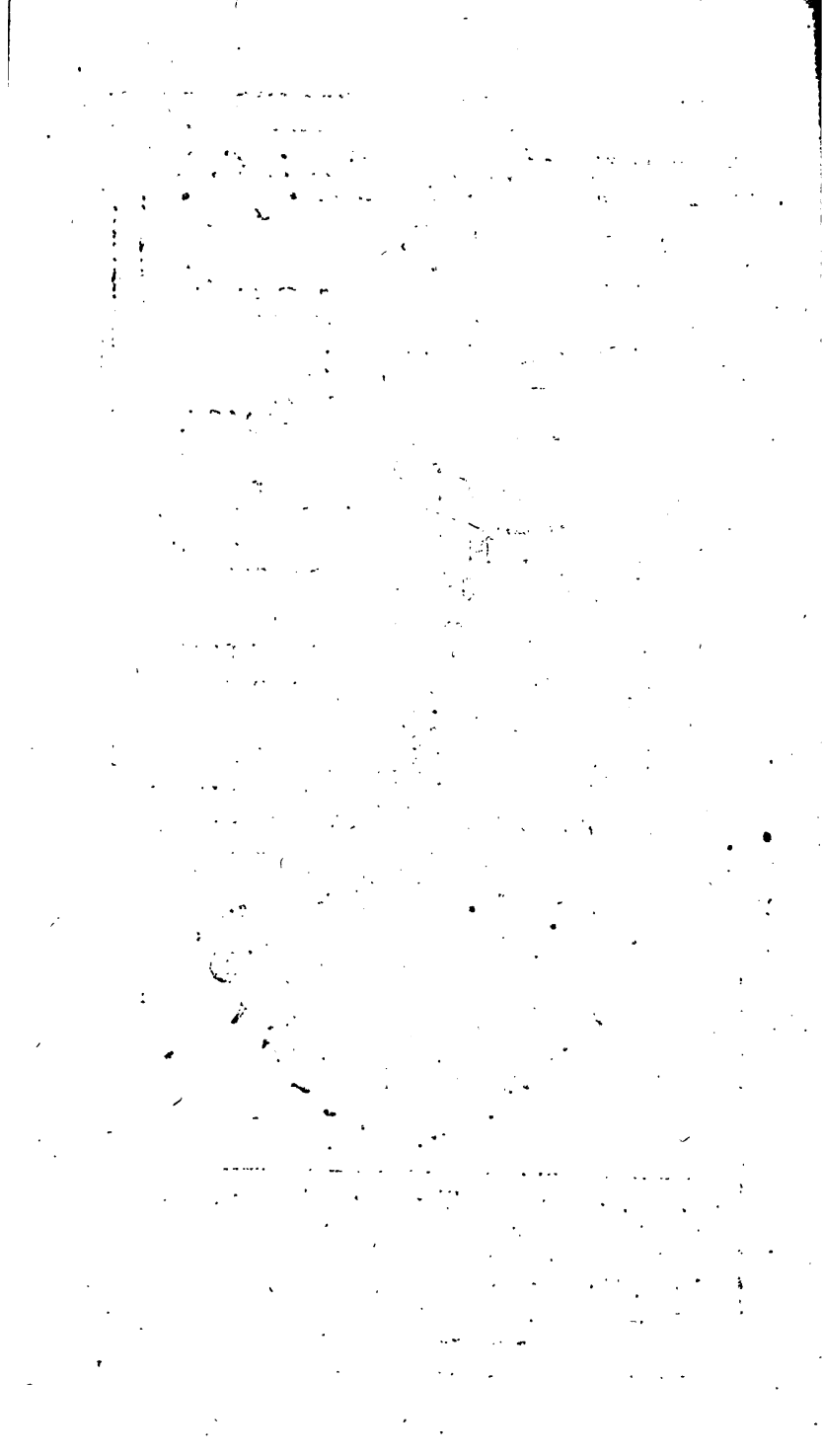
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T H E P R E F A C E.

AMONG all the Sciences, there is none which so much enlarges the Mind, and corrects the Judgments as that of the Mathematicks : It is, indeed, the Basis and Foundation of all true Philosophy ; and therefore PLATO wrote over the Door of his School,

οὐδ' εἰς ἀγῶνιστον ἐγγεῖναι

Nor have there been wanting Persons, in all Ages, who have cultivated this most valuable Part of Learning ; and to what a considerable Height the Ancients have advanced it, is evident from the Writings of EUCLID, ARCHIMEDES, APOLLONIUS PERGÆUS, PROCLUS, DIOPHANTUS, THEON, &c. which are transmitted down to us. In the Practical Part likewise, there have been several, who have distinguished themselves by their Care and Industry ; as ARISTYLLUS and TIMOCHARIS, who lived about 300 Years before the Christian Æra, HIPPARCHUS, and PROLOMY, whose Observations on the Stars have been of great Use to the Modern Astronomers, in determining the Precession of the Equinoctial Points ; the Quantity of which is so small, that it requires an Interval of many Years to ascertain it. This was first found out by Observation ; but has since been demonstrated a priori from the Laws of Gravity by the excellent Sir ISAAC NEWTON, in his Book of the System of the World : But tho' the Ancients were pretty well acquainted with the Planetary Astro-

mony, there was one thing in which they were grossly deficient; namely, the Astronomy of Comets: These they look'd upon only as sublunary Vapours, or Airy Meteors, and so never thought it worth their while to observe their Phenomena, or write about them.

BUT TYCHO BRAHE, by the Help of more large and accurate Instruments than the Ancients were possessed of, found that the Comet, which appeared in the Year 1577, had no diurnal Parallax that was sensible; and consequently, that it was not only no Aerial Vapour, but also much higher than the Moon: So likewise, on the other hand, from its annual Parallax, he argued, the Descent of it into the Planetary Regions; but yet they were ignorant of the Form of the Orbits, in which these Bodies moved, till, by the Help of Mr. Flamsteed's most accurate Observations on the Comet of 1680, the illustrious NEWTON shew'd that they mov'd round the Sun in Parabolical, or rather in every Eccentric Elliptical Orbits and described Areas (taken at the Centre of the Sun) proportional to the Times. Since then the Great Dr. HALLEY has compiled a Table of their Motions, (viz. such of them as have been hitherto observed) and attempted to bring them under an Arithmetical Calculation, and has foretold, that in all Probability, the Comet, which appeared in the Year 1305, will return in the Year 1758: And if it should so return, there is no Reason to doubt, but that the rest may return also; and then Astronomers will have a large Field wherein to exercise themselves, for many Ages, before they will be able to know the Number of these many and great Bodies revolving about the common Centre of the Sun, and to reduce their Motions to certain Rules.

In Question the 11th, Book the First, for January, February and March, I gave you an Example of Dr. Halley's Method of finding the Angular Motion at the Sun of a Comet in a Parabolical Orb, from the Area and perihelion Distance being given: And those, who have a Desire to see the same done in an Elliptical Orbit, may consult Dr. KIEL's Astronomical Lectures in the Solution of KEPLER's Problem. Having finished Mr. COTTS's Preface to Sir ISAAC NEWTON's Principia,

pia, in the last Book, I shall, in this, give you the general Laws of Motion, together with some Definitions of Matter, Space and Time, being excerpts from Mr. WHISTON's Physical Lectures: And now I must inform my Readers, That as the LADIES DIARY will be published in December next, I shall, for that Reason, omit putting out a Book for that Quarter; because most of those, who buy this Treatise, I may suppose are engaged therein.



ADVERTISEMENT To all LOVERS of INGENUITY.

THE Author intending to publish the next Quarterly Book the Beginning of March ensuing, desires that such Gentlemen and Ladies, &c. as think fit to encourage this Undertaking, either by promoting and recommending the Sale thereof, or by sending such Subjects, either in Verse or Prose, as are suitable to this Design, would please to direct their Letters to Mr. THO. GENT, Printer, near the Star in Stone-Gate, YORK, Post paid, before the End of February next, where they will be carefully forwarded to the Author.

Whoever send either Enigmas, or Arithmetical Questions, are desired to give the Solutions along with them, to prevent all Mistakes, or Ambiguity in the Terms: And I do assure the Buyers of this Treatise, that, in Process of Time, they shall have Questions in all the Branches of Mathematicks, viz. Arithmetical, Nautical, Geographical, Mechanical, Trigonometrical, Astronomical, Algebraical, and in Fluxions, together with exponential Equations, and the Construction of Algebraic Equations, and finding their Loci; to suit the Tastes of all Persons, and render the Work generally useful.

Miscellanea



Miscellanea Curiosa, &c.



DEFINITIONS Preparatory to MATHEMATICAL PHILOSOPHY.

(1.) **B**ODY, or Matter, is an extended Substance, solid or impenetrable ; of itself merely passive, and indifferent to Motion or Rest, but capable of any Sort of Motions whatever, and of all Figures and Forms. I call it a Substance extended, because that it possesseth some Part of the extended Space but solid and impenetrable, not because it cannot be penetrated by Space, or perchance by other incorporeal Substances, but because it is impenetrable by all other Matter ; and upon that Account, it doth eminently claim the Name of *Solid*. I put in the Definition, (it's being indifferent to Motion or Rest) not that I reckon Motion, as well as Rest, a Thing plainly negative or privative ; but because the Conception of a Body as in Motion, is as easy and familiar, as of a Body at Rest. I call it in itself passive, because we perceive nothing of Action, or Energy, or of a Power of moving itself, either in its Nature, or Affections ; but, on the contrary, from all the Phenomena of Motions we every where meet with its Inactivity. But I say, that it is capable of any Sort of Motion, and of all Figures and Forms, since the daily Appearances in the World, and infinite Experiments shew this to be the Nature of it ; Time, Space, Place and Motion, being Things so well known to all, scarce need to be defined : But, however,

however, for the taking away some Prejudices out of Mens Minds, it is very expedient, that we should distinguish these Quantities into Absolute or Relative, True and Apparent, Mathematical and Vulgar, and so in a Sort describe them, which we shall do in the following Manner.

(2.) TIME Absolute, True and Mathematical, is an Eternal and Equable Duration, compounded of Parts, succeeding each other in an immutable Order ; for in itself, and its own Nature, it flows equably : Nor doth it depend on the Motion of Things, much less on their Rest, nor indeed upon their Existence. For whether any Thing were moved or not, whether any Thing did exist, or nothing at all were in being, it would be all one in this Case : Time flows equably, whatsoever Relation any other Things have to one another.

(3.) RELATIVE Time, or that which is Apparent and Vulgar, is some sensible and external Measure of Duration, (whether it be by Motion, or some other way ; whether it be accurate and even, or uneven ;) which is used instead of the true Time, as an Hour, Day, Month, Year, the Duration of the World, or any System from the Beginning to the End, &c. In Astronomy, Absolute Time is distinguished from Relative, by the Equation of the Vulgar Time : For the natural Days are unequal, which are nevertheless commonly taken for equal in the measuring of Time. This Inequality Astronomers correct, that they may measure the Heavenly Motions by a truer Time. It is possible, that there may be no even Motion at all, by which Time may be accurately measured : All Motions may be accelerated and retarded ; but the flowing of absolute Time cannot be changed. The Duration or Perseverance of the Existence of Things is the same, whether their Motions be swift, slow, or none at all ; consequently, this Duration is justly distinguished from its sensible Measures, and collected from them by Astronomic Equation. For this is what Astronomers have labour'd after, namely, that, from the unequal Motions of the Celestial Bodies, they might find an equable Motion about some Centre, from whence they may more easily and accurately measure Duration, that flows equably.

(4.) ASS-

§ MISCELLANEA CURIOSA, &c.

(4.) **ABSOLUTE**, True, and Mathematical Space, is an Extension penetrable, indisterpible, immoveable, infinite, eternal, and every where similar to itself; whether or no such an Extension doth really exist distinct from Matter, is another Question. But that this is the common Notion of Space, must be allowed, and therefore is to be taken as a Definition. For so Geometricians do at first define a Circle, a Square, a Triangle, &c. not troubling themselves with the Question, whether such Figures do really exist, or no. We ought therefore to lay down such a Description of Space before hand, lest afterwards there should arise a Strife about Words; that we may afterwards enquire, whether it be the Idea of a Thing really existent.

(5.) **RELATIVE** Space, (which also is commonly called Place) is the Measure of absolute Space, or any moveable Dimension; which is defined and determined by our Senses, from its Position with respect to certain Bodies, and is commonly used by the Vulgar for immoveable Space. As the Dimension of an Aerial, Celestial or Subterraneous Space, is defined by its Position, in respect of the Earth. Space, absolute, and relative, are the same in Species and Magnitude; but do not always remain the same in Number: That is, if we consider the Space or Cavity contained in any Vessel whithersoever the Vessel is moved, the Space or Cavity included in the Sides thereof will always be of the same Nature, by reason that Space is every where similar to itself; and will remain always of the same Magnitude, because of the given Magnitude of the containing Vessel. But it doth not remain the same Space numerically, for that is changed perpetually by the Motion of the Vessel. In like manner, if the Earth be moved with an annual Motion about the Sun, the Space of our Air, which relatively, and in respect of the Earth remains still the same, that is of the same Nature and Quantity, will be sometimes one Part of absolute Space, sometimes another, and so will be changed perpetually. For indeed, as the Order of the Parts of Time is unchangeable, so likewise is the Order of the Parts of Space; although the Things which are in them are continually moved and changed. For Times
and

and Spaces are, as it were, the Places of themselves, and of all other Things; which are placed in Time, as to Order of Succession, and in Space as to Order of Situation. They are Places by their Essence, and it is absurd to say, that the primary Places can be moved. These therefore are the absolute Places; and the Translations, which are from these Places, are the only absolute Motions. But then, because the Parts of Space cannot be seen in themselves, or distinguished from each other by our Senses, instead of them we use sensible Measures, defining all Places from the Positions of Things, with respect to some Body, which we look upon as unmoved, and their Distances from the same; and estimating all Motions with Respect to the said Places, and so far as we conceive Bodies to be transferr'd from them. And thus, instead of absolute Places and Motions, we make use of relative; and this indeed not unfitly in common Affairs: But in Philosophical Matters we ought to abstract from the Senses: For it is possible, that no Body is really quiescent, to which Places and Motions may in this Manner be referred.

(6.) A *AN* Absolute Place is that Part of the absolute Space which the Body possesseth.

(7.) A *RELATIVE* Place is that Part of Relative Space which a Body possesseth. I say that Place is a Part of Space, not the Situation of a Body, or the ambient Surface, as some have defined it. For the Place of equal Solids are equal; and the same Quantity of Matter always possesseth the same Quantity of Space, of whatsoever Figure or Density it is. As for Example, the Places of a Sphere, and of a Cube of the same absolute Magnitude will be equal, or they will fill and be adequate to equal Places; although the ambient Surfaces, by Reason of the Dissimilitude of the Figures will be unequal, and so in all other Figures. Further, the Motion of the Whole is the same with the Sum of the Motions of all the Parts; that is, the Translation of the Whole from its Place is the same with the Sum or aggregate of the Translations of all the Parts from their Places; and consequently, the Place of the Whole is the same with the Sum of the Places of the Parts, and therefore is internal, and in the whole Body. But Situations, properly speaking, have no

Quantity, and cannot be said to be greater or lesser, neither are so much Places as Affections of Places.

(8.) **ABSOLUTE** Motion is a Translation of any Body or Substance from one absolute Place, or immoveable Space, into another absolute Place or immoveable Space.

(9.) **RELATIVE** Motion is a Translation of a Body from a relative Place, or some moveable Space, into some other relative Place, or moveable Space; or a transferring of a Body from the Neighbourhood of some ambient Bodies into the Neighbourhood of others; or, lastly, a Translation of a Body from its Situation amongst some certain Bodies into another Situation.

Thus in a Ship, which is under Sail, the relative Place of a Body is that Part of the Ship in which it is; or that Part of the whole Cavity which such a Body fills; and which consequently is moved with the Ship: And the relative Rest of that Body, is the abiding thereof in the same Part of the Ship, or Cavity. But the true Rest thereof is its Continuance in the same Part of the immoveable Space. From whence, if the Earth did truly rest, the Body, which relatively rests in the Ship, would be moved truly and absolutely with the same Velocity where-with the Ship is moved on the Earth.

BUT if the Earth be also moved, the true and absolute Motion of the Body will arise, partly from the Motion of the Earth in the unmoved Space; partly from the relative Motions, both of the Earth, and of the Body in the Ship; and from these relative Motions will arise a relative Motion of the Body on the Earth. Thus if that Part of the Earth, in which the Ship is, be moved really towards the East with a Velocity of 10010 Parts, and the Ship be carried towards the West by the Wind with a Velocity of 10. Parts; and the Mariner walk in the Ship towards the East with 1. Part of Velocity: The Mariner will be moved truly and absolutely in the unmoved Space towards the East with 10001. Parts of Velocity, and relatively on the Earth towards the West with 9. Parts of Velocity.

(10.) **THE** Quantity of Matter is the Measure of the same, arising from the Density and the Magnitude thereof conjunctly.

Thus Air, which is as dense again as some other Air, and possesses double the Space, is fourfold in Quantity to the

the other. And if a Cubic Vessel contain Air, which by Compression is reduced into a lesser Cube, the Density in the lesser Cube will be to that in the greater, as the greater Cube is to the less; or in the triplicate Proportion of the Sides reciprocally; and the Distances of the Particles of Air which are like, and in like Manner posited, will be in the Proportion of the Cubic Sides. The same Thing is to be understood of Snow or Powders condens'd by Compression or Liquefaction: And there is the like Reason of all Bodies in whatever Manner condens'd. We have no Regard in this Place to a *Medium* pervading the Interstices of the Parts, if there be any such: But we shall call this Quantity of Matter, (which is to be reckon'd from the Density and Magnitude conjunctly) every where hereafter Body or Mass. And the same is known by the Weight of every Body; for an equal Quantity of Matter, of what Sort soever it is, doth equally gravitate; as is manifest by Experiments of *Pendulums* which have been most accurately made. And from hence it is certain, that either there is no *Ethereal Medium* pervading the Pores of Bodies; or if there be any, seeing it doth in no wise gravitate nor hinder the Motion of Bodies, it ought to be reckoned Matter differing from that of all other Bodies; yea, in speaking properly, it deserves not the Name of Body or Matter at all. But we shall have Occasion to say more of this hereafter.

(II.) THE Quantity of Motion is the Measure of the same, arising from the Velocity, and from the Quantity of the Matter conjunctly.

THE Motion of the Whole is the Sum of the Motions of all the Parts; and consequently in a Body double of some other, and mov'd with equal Velocity, the Motion is two-fold of the Motion which is in the other Body; and in the double Velocity of the greater Body it is four-fold. The Quantity of Matter therefore is equal to the Rectangle of the Density drawn into the Magnitude; and the Quantity of the Motion equal to the Rectangle of the Velocity drawn into the Quantity of the Matter. From which Principle the Forces of Machines are easily deduced. For wheresoever in the *Equilibrium* of Machines a Body is greater, there the Celerity of that Bo-

dy will be so much the lesser ; and where the Body is less, the Celerity will be so much the greater ; so that the Quantity of Motion resulting from the Body, as drawn into its own Velocity, is equal on both Sides ; as will be more largely set forth hereafter.

(12.) THE innate Force of Matter is a Power of resisting, whereby every Body, as much as it can, perseveres in its own State of resting, or moving uniformly straight forwards in a right Line.

THIS Force is proportional to the Body, and differs nothing from the Inactivity of the Body, but in the Manner of conceiving it ; by which it comes to pass, that a Body is not without Difficulty put out of its State, whether of Rest, or Motion. From whence, by a very significant Name, it may be called the Force of Inactivity. But a Body exercises this Force, only when it is acted upon by some Force from without : Under which Exercise of its innate Force, it is considered in a double Respect, to wit, as Resistance and Impulse. Resistance, as far as it struggles with the impressed Force, in order to preserve its own State ; Impulse, as the same Body by not easily giving way to the Force of the resisting Obstacle, endeavours to change its State. Indeed, it seems most proper to attribute Resistance to quiescent, and Impulse to moving Bodies ; and I should assign any *Impetus* whatsoever, where one of the Bodies is at Rest, to the positive Force of the moved Body, rather than to the negative Force of the quiescent One.

(13.) THE impress'd Force is an Action exercised on a Body for the changing its State, whether of Rest, or uniform direct Motion.

THUS this Force consists in Action alone, and remains not in the Body at all after the Action : For the Body perseveres in every new State by its sole Force of Inactivity. Now Force impress'd is from divers Causes, as from a Blow, a Pressure, or Tendency to a Centre.

[To be continued in the next.]





ANSWERS to the last ÆNIGMAS.

- | | |
|----------------------------|--------------------------|
| 1. The Tackling of a Ship. | 4. An Act of Parliament. |
| 2. Sea-Coals. | 5. A Pin-Cushion. |
| 3. The Load-Stone. | |



An ANSWER to the Four First ÆNIGMAS, by W. N.

FROM *Newcastle* to *London*, full freighted with *COAL, 2.
 In *January* last we set Sail ;
 In the midst of our Passage our Ship fell to rowl,
 Having met with a very hard Gale.
 Tho' touch'd by the *MAGNET, our Needle stood wrong, 3.
 In vain it was Anchor to cast ;
 But our Ship proved tight and the *TACKLE was strong, 1.
 So we got safe to *London* at last.
 There by *ACT of PARLIAMENT, charg'd on each Cargo, 4.
 For building St. PAUL's noble Dome.
 A Duty we paid, and without further Embargo
 We clear'd, and sail'd merrily home.

The Fifth ÆNIGMA, answered by E. K.

YOUR Fifth ÆNIGMA surely means
 * A CUSHIONET, well stockt with PINS. * 5.

All the ÆNIGMAS answered by F. B.

To Miss ————

SOONER shall *PITCH and *COAL be white, * 1. 2.
 The *MAGNET know no more a Pole, * 3.
 Than I'll forsake thee, dear Delight !
 If mine ; I'd love thee as my Soul.
 What need the *LAWS tye Men to one, * 4.
 If all our Sex did love like me ?
 Then each would stick unto his own,
 As thy *PIN-CUSHION does to thee. * 5.

On

On the DEATH of a BELOVED WIFE.

Written by Her HUSBAND.

WHILE pining Anguish, wild Despair,
Increase my Pangs, prolong my Care ;
Depriv'd of all my Soul held dear,
Enchanting Joy, and Love sincere :
While round the gloomy Scene's display'd,
And Death still deepens ev'ry Shade ;
Sad, silent, dark, the Pomp of Woe !
Shall Sorrow's Eye forbear to flow ?
Flow still, ye Tears ! ye Sighs complain !
— But Sighs and Tears alike are vain !

See there all pale and dead she lies :
For ever flow my streaming Eyes !
Fly, *Hymen*, with extinguish'd Fires !
Fly Nuptial Bliss, and chaste Desires !
CLEORA's fled, the loveliest Mind ;
Faith, Sweetness, Wit, together join'd !
— Dwelt Faith, and Wit, and Sweetness, here ?
O view the Change, and drop a Tear !
Once in these Eyes each Grace was seen,
And Love and Mildness shone serene :
Once soft Persuasion tun'd her Tongue,
As Truth sincere, and sweet as Song :
Once this cold Hand could touch the Lyre,
And ev'ry tender Thought inspire.
Now sinking to its Parent Clay,
All chang'd the Body seems to say,
— Thus Life, a Shadow, fleets away !
O whisper still, thou Voice divine !
Thine be the Lore, Attention mine ;
And while this awful Object lies
Expos'd before my weeping Eyes,
Teach me some Genius from on high,
Like her to live, like her to die ;
To emulate the Paths she trod,
All humane, gen'rous, great, and good !
Like her, tho' Rage of Death, to charm,
And ev'ry sting of Pain disarm !
Rise as she rose, a spotless Soul,
Who aim'd at Joys beyond the Pole ;

And,

MISCELLANEA CURIOSA, &c. 15

And, raptur'd on the Verge of Day,
Smil'd to behold the shining Way.

But hark ! the sadly solemn Bell,
Sullenly sounds my last Farewell.

Lo ! round the Corpse, the plaintive Throng,
Slow-moving, silent walk along.

The Torch that lends its mournful Light,

The mystic Pray'r, the Fun'ral Rite,

The weeping Friends, th' expecting Ground,

The silent Horror all around,

Have tempted Sorrow from her Cave ;

And now she hovers o'er the Grave :

Now sinks our Hearts, impails our Eyes,

And bids a gen'ral Groan arise ;

Exclaims that Man was doom'd to mourn,

And sits in Pomp to guard the Urn.

'Tis done ! — Oh ever Dear, adieu !

Each tender Name is lost in you.

Adieu ! thou once kind, lovely Fair,

Soft Spring of Joy, Relief from Care !

O Rest ! may Love with ev'ry Grate,

And ev'ry Virtue, guard the Place ;

While me receives the lonely Bed,

Sad, prostrate, silent as the Dead !

Restless, I press the well-known Place,

And vainly seek the dear Embrace ;

While slow and drear the Minutes roll,

And Anguish racks my inmost Soul.

— But see ! what Heav'nly Power serene

Darts gently thro' the gloomy Scene ?

'Tis She ! ingliding from above ;

The same her Form, the same her Love !

“ Weep'st thou, my Dearest ? Weep no more !

“ The transient Scenes of Life are o'er ;

“ New Worlds now open to my View ;

“ Bliss, Knowledge, Virtue, boundless, true ;

“ Where Souls with social Raptures glow ;

“ While Sin and Vengeance reign below.

“ Hence nightly I, thy Guardian Pow'r,

“ For ever conscious of the Hour,

“ That join'd our Hearts, descend to keep

“ My dearest Charge ; to watch thy Sleep ;

“ Hint

" Hint softer Dreams ; to chase away
 " Black Error's Mist, and bright display
 " The Form of Virtue to thy Sight ;
 " Dart o'er thy Soul a stronger Light ;
 " In Reason's Voice to whisper still ;
 " To purer Bliss direct thy Will ;
 " A beamy Cloud around you throw,
 " And viewless guide you as you go.
 " Lo ! few short Moments roll'd between ;
 " I present change the darksome Scene ;
 " Dispel the awful Shades of Death ;
 " And gently ease your parting Breath ;
 " Glad hail you to the Realms above,
 " Dear, blest, immortal, as our Love.
 " Thus while we leave thy lifeless Clay,
 " To some bright Orb thy Soul convey,
 " Where Virtue, Truth and Pleasure join ;
 " And, raptur'd, say — This Seat be thine !
 " There Knowledge, great as Souls can know,
 " Shall purge the Errors learn'd below,
 " Enlarge thy Pow'rs, improve thy Sight,
 " And shew thee Truth in native Light.
 " See there yon happy Shades employ
 " Their Hours in Bliss and social Joy ;
 " High-rais'd on Virtue's Eagle Wing,
 " The Patriots act, the Poets sing ;
 " With purer Fires the Lovers glow,
 " Than Youth or Sense inspire below.
 " Here join we then the Kindred Race,
 " That springs to meet our soft Embrace ;
 " Or, in some sweet sequester'd Grove,
 " Mix Flame with Flame, and Love with Love.
 " Hence wing'd by Thought excursive fly
 " From Orb to Orb, and range the Sky ;
 " View Wisdom, Pow'r, and Goodness shine
 " Thro' Nature's Frame ; their Source divine !
 " — O call these Scenes to thy Relief ;
 " Bright future Scenes, and calm thy Grief ;
 " Live happy, nourish still the Love,
 " That blest on Earth, and joins our Souls above."
 She spoke, she smil'd, she soar'd away ;
 While Comfort glanc'd a healing Ray.

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QUESTION the 1st, answered by R. G.

CONSTRUCTION.

ASSUME Bx = any Number of equal Parts at Pleasure, suppose 48. and make $x C = x B$ (*Vid. Fig. 1.*) Then upon BC describe an Arch of a Circle BAC capa-

ble of containing an Angle of $107 : 00$ by the 33d Prop. of the 3d. of Euc. Then make the Angle $BxA =$

$75 : 00$ and draw the Line xA , and then AB , AC . upon xA set of $xn = 27$. and draw the Lines xK , xS parallel to BA , CA , I say the Triangle KxS is the Triangle required.

CALCULATION.

Having assumed $Bx = 48$. and the Angles RBx , BRx being known $= 17 : 00$ and $73 : 00$ in the Right Angled Triangle BRx , we may find $BR = 50.2$ Poles and $Rx = 14.7$. But $RA = RB$ as being Radii of the same Circle, and the Angle $AxR = 165 : 00$ ($= 90 : 00$ more the $\angle BxA$). Hence in the Triangle AxR we have sufficient to find $Ax = 36.0$. Now the Triangles BxA , Kxn being similar, As $Ax : xB :: nx : xK = 36$. Poles. Consequently $KS = 72$., $Kn = 39.0$ $Sn = 50.3$.

QUESTION the 2d, answered by L. N.

In Fig. 2d. Put $CM = a$; $= 4000$. $FM = x$; $CF = a - x$; $d = .5236$ Then is $DF = \sqrt{2ax - x^2}$. But by Page the 419th of WARD'S *Young Mathematician's Guide*, the Solidity of the Segment DMB is equal to $6dax^2 - 2dx^3$; and the Solidity of the whole Sphere $= 8da^3$; consequently the Solidity of the Segment $DTB = 8da^3 - 6dax^2 + 2dx^3$: But according to the Tenour of the Question, we shall have $48d^2a^4x^2 - 16d^2a^3x^3 = 64d^2a^5 - 96d^2a^4x^2 + 32d^2a^3x^3 + 36d^2a^2x^4 - 24d^2ax^5 + 4d^2x^6$, divide by $4d^2$ and transpose the Terms, we have $-x^6 + 6ax^5 - 9a^2x^4 - 12a^3x^3 + 36a^4x^2 = 16a^6$; consequently $x = 3345$. and hence $FC = 655$. Miles; and $DF = 3946$. But by similar Triangles $FC : FD ::$

C

FD:

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FD : FS = 23778. from which subtracting FM remains
SM = 20428. Q. E. I.

QUESTION the 3d, answered by S. D.

Case the First, CONSTRUCTION.

In Figure the 3d. Draw AD, and set off AE, then make the Angle AEq = to the Complement of the Angle

BEC to 180 : 00 and make Eq = ED; and draw Aq, then circumscribe this Triangle with a Circle, and from the Point E draw the Diameter EB, join EB, qB, AB, then will qB = DC which erect perpendicular upon AD, and draw CE which will compleat the Scheme.

TRIGONOMETRICAL CALCULATION.

In the Triangle AEq there is given AE, Eq, and the contained Angle to find the Angle qAE = Angle qBE; = Angle ECD. In like Manner the $\angle AqE = \angle ABE$; lastly we have in the right-angled Triangles ABE, ECD, all the Angles and a Side to find AB, CD.

ALGEBRAIC SOLUTION.

Put AE = b; AB = x; It. d = Cos. $\angle$ BEC. then is
ED = c; CD = y;

Bq = AD = m; Cq = x - y; $\sqrt{b^2 + x^2} = BE$; and
 $\sqrt{c^2 + y^2} = EC$; and BC = $\sqrt{m^2 + y^2 - 2xy + x^2}$;
then by Problem the 5th, Page 87, Vol. 2. of Ozanam's Cursus
 $b^2 + x^2 + c^2 + y^2 - m^2 - y^2 + 2xy - x^2$

$\frac{2\sqrt{b^2c} + c^2x^2 + b^2y^2 + x^2y^2}{2\sqrt{b^2c} + c^2x^2 + b^2y^2 + x^2y^2} = d$. but by
the Question $b^2 + x^2 = c^2 + y^2$. and hence $x = c^2$
+ $y^2 - b^2$ in the above Step for x^2 and x substitute their
Values, and expunge the Quantities which destroy one
another, then $\frac{b^2 + c^2 - m^2 + 2y\sqrt{c^2 - b^2 + y^2}}{2\sqrt{c^4} + 2c^2y^2 + y^4} = d$. But

the Denominator of this Fraction being a perfect Square,
it will be (by putting $-p = b^2 + c^2 - m^2$; $-q =$
 $c^2 - b^2$, &c.) $\frac{-p + \sqrt{4y^4 - 4qy^2}}{2c^2 + 2y^2} = d$; and

$\sqrt{4y^4 - 4qy^2} = 2dc^2 + 2dy^2 + p$ and by Involution,
Transposition, and Substitution, we have $-y^4 + 2gy^2$
 $= -b^2$;

$$= -b; \text{ and } y = \sqrt{g} \pm \sqrt{g^2 - b} = 65.2 \text{ and } AB = 54.5.$$

(Case the Second) CONSTRUCTION.

Draw AB, CD, AD, and BC (as in Figure the 4th,) upon BC, describe an Arch of a Circle capable of con-

taining an Angle $= 49:00$, where it cuts the Line AD as at E, draw BE, CE.

TRIGONOMETRICAL CALCULATION.

Draw the several Lines, as in the said Scheme *vm* perpendicular to BC, and *Bq* parallel to AD. Then in the Triangle *Bvm* there is given *Bm*, and the $\angle$ s to find *Bv*: (for $BC = 2Bm$, and the $\angle CBq$ is easily found because in the right-angled Triangle *BqC*, there is given *Bq* = *AD*; and $Cq = CD - AB$;) from the $\angle vBm$ subtract the $\angle CBq$, remains the $\angle vBq$; and this last

subtracted from $90:00$ leaves the $\angle vBA$. in which Triangle is given *Bv*, *BA*, and the $\angle vBA$ to find *Av*.

and the $\angle BAv$; subtract this $\angle$ from $90:00$ leaves the $\angle vAE$, in which Triangle are given *Av*, $\angle vAE$, and *vE*, ($= vB$) to find *AE*, and consequently *ED*, &c.

ALGEBRAIC SOLUTION.

Put $Ev = b$; $Ew = x$; $wv = y$, then is $bb = x^2 + y^2$ for $Ev = Bv$ is easily found, because the Side *Bm* is known and all the Angles in the Triangle *Bvm*, but the Angle $vSm = \angle BCq$ the Triangles being similar, consequently *vS*, *BS* are given; Then as $BC : Cq :: BS : Sr$, and as $BC : Bq :: BS : Br$. which are known: from *vS* before found, subtract *Sr* and put *vr* the Difference $= d$, and put $BA = b$; Then is $d + y = b$; and $y^2 = b^2 - 2bd + d^2$; for y^2 substitute its Value and $b^2 = x^2 + b^2 - 2bd + d^2$. $x = \sqrt{b^2 - b^2 + 2bd - d^2} = Ew$; from *Aw* = *Br* before found, subtract *Ew*, remains *AE* = 12.6 and *ED* = 48.4. Q. E. F.

Case the Third, CONSTRUCTION.

Draw $BC = AD$ (as in Figure the 5th) and make $Bm = AE$, from *m* erect the indefinite Perpendicular

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mg, upon *BC* describe an Arch of a Circle capable of containing an $\angle$ of $44 : 00$ and where it cuts *mg* as at *E* draw *AD* parallel to *BC*, and let fall the Perpendiculars *BA*, *CD*, and draw the rest of the Lines as in the said Scheme.

TRIGONOMETRICAL CALCULATION.

In the Triangle *Bxb* is given *Bx* and the Angles to find *Bb*, *bx*; and the $\angle Bbx = \angle Bpm$. Then by similar Triangles As $\left\{ \begin{array}{l} Bx : Bb :: Bm : Bp. \\ Bx : xb :: Bm : mp. \end{array} \right.$

Lastly in the Triangle *Epb* are given *Eb* ($= Bb$) and *bp* ($= Bp - Bb$) and the $\angle Epb = \text{Comp. of } Bpm \text{ to } 180 : 00$ to find *Ep*. But $Ep + mp = Em = AB = CD$.

ALGEBRAIC SOLUTION.

Put *b* = *NS*, $\angle BEC$; *d* = *AE*; *n* = *ED*; *c* = *BC* *x* = *NS*, $\angle EBC$; *y* = *NS*, $\angle BCE$; Radius = Unity. As *b* : *c* :: *x* : $\frac{cx}{b} = CE$. As *b* : *c* :: *y* : $\frac{cy}{b} = BE$.

As $1 : \frac{cy}{b} :: x : \frac{cyx}{b} = Em = BA = CD$. But by 47.

Prop. 1. Euc. $\frac{c^2 y^2 x^2}{bb} + dd = \frac{c^2 y}{bb}$ and $\frac{c^2 y^2 x^2}{bb} + nn =$

$\frac{c^2 x^2}{bb} : y^2 = \frac{b^2 d^2}{c^2 - c^2 x^2}$ by the first, and by the last Step

$c^2 x^2 - c^2 x^2 y^2 = b^2 n^2$. and putting for y^2 its equal, we

have $c^2 x^2 - \frac{c^2 b^2 d^2 x^2}{c^2 - c^2 x^2} = b^2 n^2$; and by Reduction,

Transposition, Division, and Substitution, $-x^4 + 2px^2 = -q$; $x = \sqrt{p} \pm \sqrt{pp - q} = .8755$ hence the Height of the Towers = $74\frac{3}{4}$ Feet.

QUESTION the 4th, answered by R. P.

Put a^3 = Hours to come, $b - a^3$ = Hours past; $b = 16$. Then by the Question we have $\sqrt{b - a^3} + 4 = b - a^3$

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$b - a^3$; Or, $\sqrt{b-a^3} = b-a-a^3$; by Involution $b-a^3 = b^2 - 2ba + a^2 - 2ba^3 + 2a^4 + a^6$ and by Transposition $-a^6 - 2a^4 + 2b - 1a^3 - a^2 + 2ba = b^2 - b$. In Numbers $-a^6 - 2a^4 + 31.a^3 - a^2 + 32.a = 240. a = 2.267$; $a^3 = 11.65$; $b-a^3 = 4.350$. So the Time was 21 Minutes past 8 in the Morning.

QUESTION the 5th, answered by the same.

Put $x =$ Number of Inches in the Diameter of the Sphere, $b = .5236$, $c = 282$, the Cubic Inches in an Ale Gallon. Then by the Question $\frac{bx^3}{c} = x \cdot bx^3 = cx$,

$x = \sqrt{\frac{c}{b}} = 23.2$ Inches and the Content is 23.2 Ale Gallons. Q. E. I.

QUESTION the 6th, answered by S. H.

Put $a =$ First Number; $\frac{e}{u} =$ Second; $u =$ Third; $b = 842$; $c = 586$; $d = 458$; Then by the Import of the Question 1. $a + e = b$; 2. $\frac{d \cdot e}{u} + au = c$; 3. $u + \frac{ae}{u} = d$;

by the Second Step, $\frac{e}{u} = c - au$; $e = cu - au^2$; and

$u = \frac{cu-e}{a}$; by the Third Step, $\frac{ae}{u} = d - u$; $ae = du - u^2$;

and $u^2 = du - ae$; Ergo $\frac{cu-e}{a} = du - ae$; $cu - e = dau -$

a^2e ; and $u = \frac{a^2e-e}{da-c}$. In the Second Step for u put its Value

and the Equation becomes $\frac{da-e}{a^2-1} + \frac{a^3e-ae}{da-c} = c$. But by

by the first Step $e = b-a$ which put for e , and we shall have $\frac{da-c}{a^2-1} + \frac{ba^3-a^4-ba+a^2}{da-c} = c$, which will give

this Equation, $-a^5 + ba^4 + 2a^3 - 2b - aca^2 + d^2 + c^2 - 1a = cd - b$; Hence $a = 17$, the First Number, ($e = 825$.) $u = 33$.

the third Number, and $\frac{e}{u} = 25$, the second Number. Q.E.J.

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The same QUESTION answered by Mr. B.

Put $a =$ First Number. } $b = 842.$ } Then by the Quest.
 $e =$ Second. } $c = 586.$ } $a + eu = b$
 $u =$ Third. } $d = 458.$ } $e + au = c$
 $u + ae = d$

1 $a = b - eu,$

2 $a = \frac{c - e}{u},$ Ergo $\frac{c - e}{u} = b - eu$

3 $u = d - ae,$

Substitute in the 2d Step for u its Value,

4 $\frac{c - e}{d - ae} = b - de + ae^2,$

Put the Value of u in the first Step, and

5 $a = b - de + ae^2,$ and $a = \frac{de - b}{e^2 - 1}$

Now in the 4th Step put for a its Equal.

6 $\frac{c - e}{d - \frac{de^2 + be}{e^2 - 1}} = \frac{de - b}{e^2 - 1};$

7 $\frac{ce^2 - e^3 - c + e}{be - d} = \frac{de - b}{e^2 - 1}$ and by
reduc'd. multiplying Cross-ways, and transposing
the Terms, we have this Equation of the
5th Power.

$$-e^5 + ce^4 + 2e^3 - 2ce^2 + d^2 - db + b^2e = bd - c$$

In Numbers. $-e^5 + 586.e + 2e^3 - 386808.e^2 + 918727.e = 385030.$
Hence $e=25, a=17, u=33.$ Q. E. J.

QUESTION the 7th, answered by J. T.

First of all (in Fig. 6.) there is given the Latitude of
the Place 40° — and the Time from Sun-rise 2 Hours or
 32° — to find his Altitude thus.

As

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As the Radius ————— " 10.000000

Is to the Sine of 30° : ————— " 9.698970

So is the Cosine of the Latitude. " 9.884254

To the Sine of the Altitude — $22^\circ 31' 9.583224$

Then (in Fig. 7th) there is given the $\angle PCB = 52^\circ$ which an Arch of One Mile will subtend supposing the Earth's Diameter 7940. Miles, and the Angle CPB =

$112^\circ 31'$, for the Angle CPN is right, and PN is the sensible Horizon of the Place P; consequently also the

$\angle PBC = 67^\circ 28' 8''$ and CP = 20961600. English Feet to find CB. As $9236715. : 20961600. :: 9237682. : 20963794$. Feet, = CB from which subtracting CP remains Bv the Mountains Height = 2194. Eng. Feet = about $\frac{2}{3}$ of a Mile.

N. B. In Strictness of Reasoning, the Sun was not full

$22^\circ 31'$ above the Horizon of the Point P on the Earth's Spherical Surface, because it was only 2 Hours between the Traveller's seeing the Sun rise from B and his stopping at P; and at B he saw the Sun when he was below the Horizon of the Point P, so that it was not quite 2 Hours from Sun-Rise: But this is so small that it will not affect the Height of the Mountain in this Computation.

QUESTION the 8th, answered by R. P.

In the right-angled plain Triangle ABC (Fig. 8th) there is given AB = 100. and BC = 63. to find the

Angle ACB = $57^\circ 47'$ which is equal to the Sun's Altitude, then in the Spherical Triangle ZP $\odot$ (Fig. 9th)

there are given all the Sides, viz. the Side Z $\odot$ = $32^\circ 13'$ the

Co-altitude; and P $\odot$ = $67^\circ 3'$ the Co. Declination:

and PZ = $35^\circ 40'$ the Co. Latitude of Scarborough, to find the $\angle ZP\odot$, The Cannon is. As

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As the Rectangle of the Sines of $P\odot, PZ$ — " 19.729907
 is to the Square of Radius — " 20. —
 So is the Rectangle under the two Excesses
 of half the Sum of the three Sides above
 each of the two Sides $P\odot, PZ$ — " 17.583436
 To the Square of the Sine of half the
 Angle $ZP\odot$ — " 17.853529
 the half of this is 8.926764 which is the Sine of $4:51$;
 So the Angle $ZP\odot = 9:42$ and the Time $11:21$
 in the Morning.

QUESTION the 9th, answered by R. F.

First of all let the greatest Cylinder be represented by
 $qwpS$ (Fig. 10th) $\sqrt{AV^2 - AC^2} = CU$ the perpend.
 Altitude of the Cone = 16.6 Feet = p ; and let AB
 = 14. = b ; $pS = x$. By similar Triangles $p : b :: p$
 — $x : \frac{bp - bx}{p} = qS$ the Diameter of the Cylinders base;

this squar'd and multiply'd by x is $\frac{b^2x^3 - 2b^2px^2 + b^2p^2x}{pp}$

In Fluxions $3b^2x^2x - 4b^2pxx + b^2p^2x = 0$ divide by
 $3b^2x$ and transpose b^2p^2x will be $x^2 - \frac{4}{3}px = -\frac{pp}{3}$. Ex-
 tracting the Root of this Equation $x = \frac{1}{3}p = 5.5333$
 Feet, the Height of the Cylinder and the Diameter of
 its Base is 9.333 Feet, consequently its Content is
 378.28125 solid Feet.

(2dly.) For the Content of the greatest Hemisphere,
 let $ynxr$ (in Fig. 10th) represent the same, by having the
 3 Sides of the Triangle CVB , the Angle at B is found
 = $67:15$. draw the Line Cx to where the Circle
 touches the Side of the Cone, which will be perpendicu-
 lar to the same: Then in the Triangle CBx there is
 given CB , and all the Angles to find Cx , the Radius of
 the Hemisphere = 6.456 Feet, which being known,
 you have Directions for finding the Content in most Ma-
 thematical Treatises (as in Ward, Page the 418.) which
 amounts to 563.315 Cubick Feet.

(Lastly)

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(Lastly,) For the Cube (in Fig. 10th) let dx or fx represent the Side of the Cube = Co its Altitude; and df the Diagonal of one of its Faces, put the Side = x ; Then is $df = \sqrt{2xx}$; and the other Symbols remaining as in the foregoing Cases, As $p : b :: p - x : \sqrt{2xx}$. And multiplying Extreams and Means we have $bp - bx = p\sqrt{2xx}$ and by Involution and Transposition $2p^2x^2 - b^2x^2 + 2b^2px = b^2p^2$. and extracting the Root x is found $\approx 6\frac{1}{2}$ Feet the Side of the Cube; hence its Content is 238.328 solid Feet, and now it appears that the Cube is the least of the three, which at 20^d the solid Foot comes to L 19 : 17 : 2 $\frac{1}{2}$. Q. E. I.

QUESTION the 10th, answered by R. M.

Draw the Scheme in Fig. 11. and produce Dv to m , and on it let fall the Perpendicular Rm ; now the Angles $PvS + Sum = 90 : 00$, also the Angles $Rvm + mvS = 90 : 00$, take away from both the common Angle Sum , and there remains the Angle $Rvm = \angle PvS$. But as the Triangles are both right-angled, the $\angle vRm = \angle vSP$. also the Sides vR, vS are equal, being Sides of the same Square, hence the Triangles $Rvm PvS$ are similar and equal, but the Triangle $Rvm =$ Triangle RDv by the 37th Prop. 3d Euc. they being constituted upon equal Bases, and between the same Parallels, for vm being equal to vP , must also be equal to vD , they being Sides of the same Square, and by a like reasoning, the Triangle KSB may be proved $= SvP = RDv$.

QUESTION the 11th, answered by I. F.

See Figure the 13th, in the last Book for April, May,

and June, AB is the Subtangent $= \frac{yx}{y}$, as is thus

demonstrated. $SB = x$; $Bb = Pn$ is $= x$; $BP = y$; $pn = y$ the Triangle Ppn may be look'd upon as rectilinear, and is similar to the Triangle APB . consequently

as $pn (y) : Pn (x) :: PB (y) : AB = \frac{yx}{y}$. But by
D the

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the Question $\frac{tp - 2px}{2t} : y :: y : \frac{yx}{y}$ and multiplying Ex-

trems and Means we have $yy = \frac{tpyx - 2pyxx}{2ty}$, Or $2ty^2y$

$= tpyx - 2pyxx$. divide by y gives $2tyy = tp - 2pxx$ and finding the Fluents on both Sides $ty^2 = tp - px^2$ Or

$y^2 = \frac{p}{t} - \frac{p}{t} x^2$. Hence the Curve appears to be an Ellipsis, wherein t is = Transverse Axis, and p = to the Parameter.

QUESTION the 12th, answered by J. T.

The Length of a *Pendulum*, which vibrates Seconds, is found to be 39.2 Inches, and the Lengths of *Pendulums* are to each other reciprocally as the Squares of their Vibrations in the same Time. Put x = Length of the *Pendulum* sought, then As 39.2 : 3600. :: x : x^2 consequently $x^2 = 3600. \times 39.2$; $x = \sqrt{3600. \times 39.2} = 120.63$ Inches, Ergo the Diameter of the Circumscribing Circle is = 104.126 Inches. Now draw the Lines as in the Scheme (Fig. 12) and put $CP = x = 104.126$; $b = 1.5$; $AP = y$; $AB = x$; Then is $BC = bx$; $CD = b^2x$; $DA = b^3x$; $AC = \sqrt{a^2 - y^2}$; $BP = \sqrt{a^2 - b^2x^2}$; $PD = \sqrt{a^2 - b^4x^2}$; Now in every quadrilateral Figure inscrib'd in a Circle, the Rectangle of the Diagonals is equal to the Sum of the Rectangles of the opposite Sides of the Quadrangle. Hence $ax + bxy = \sqrt{a^2 - y^2} \times a^2 - b^2x^2$; and $b^3ax = \sqrt{a^2 - y^2} \times a^2 - b^4x^2 + b^2xy$. And by Transposition, Involution, &c. we have $x^2 = \frac{a^3 - ay^2}{3.25a + 3y}$ and

$x^2 = \frac{a^3 - ay^2}{16.452a - 15.188y}$; Ergo $3.25a + 3y = 16.452a - 15.188y$. $y = \frac{13.202a}{18.188} = 75.6$; Hence $x = 30.8$

and the Sides are = 30.8 ; 46.2 ; 69.3 ; 103.95 ; and the Area of the Trapezium 3339.2. Again (in Fig. 13) Put $a = 104.126$, $b = 20$; $AB = x$; $BC = x + b$; $CD = x$

$$= x + 2b; DA = x + 2b; AP = y; AC = \sqrt{a^2 - y^2}; PD$$

$$= \sqrt{a^2 - x^2 - 4bx - 4b^2}; PB = \sqrt{a^2 - x^2 - 2bx - bb}$$

Then by the fore-mention'd Theorem $PC \times AB + PA \times BC = PB \times CA$. and $CA \times PD + PA \times CD = PC \times AD$.

$$\text{That is } ax + xy + by = \sqrt{a^2 - y^2} \times a^2 - x^2 - 2bx - bb$$

$$\text{And } \sqrt{a^2 - y^2} \times a^2 - x^2 - 4bx - 4b^2 + xy + 2by = ax + 3ba$$

The first squar'd, transpos'd, and divided by a gives $2ax^2 + 2x^2y + 2bxy + 2bax + b^2a + ay^2 = a^3$. The second, transpos'd, squar'd and divided by a is $2ax^2 + 10bax + 13b^2a + ay^2 - 12b^2y - 2x^2y - 10bxy = a^3$ make these two Equations equal to one another, and they give $y =$

$$\frac{8bax + 12b^2a}{4x^2 + 12bx + 12b^2} \quad \text{Substitute for } y \text{ and } y^2 \text{ their Values, and we shall have the following Equation}$$

$$2ax^2 + 2bax + b^2a \frac{+ 16bax^3 + 40b^2ax^2 + 24b^3ax}{12bb + 12bx + 4xx} + \frac{+ 64b^2b^3x^2 + 192b^3a^2x + 144b^4a^3}{16x^4 + 96bx^3 + 240b^2x^2 + 288b^3x + 144b^4} = a^3$$

and by converging Series $x = 39.8$, $AC = 87.7$, Hence the Sides are, viz. $AB = 39.8$, $BC = 59.8$, $CD = 79.8$; $DA = 99.8$; and the Area of the Trapezium 4351.8

QUESTION the 13th, answered by J. T.

Here is given $BSAWC = c = 179.8$, and the Circumference of the Circle BEC , (Fig. 14.) equal to 502.656 Inches, by which the Diameter BC is found $= 160$ Inches, and $BD = 80$. Put this $= y$; $AD = x$; $BbsA = \frac{1}{2}c = d = 89.9$ and the Parameter $= p$; then by the Property of the Parabola $px = y^2$, and

$$px = 2yy; \text{ and } x = \frac{2yy}{p}; \text{ and } x^2 = \frac{4y^2y^2}{pp} : \text{ But the}$$

$$\text{Fluxion of the Arch } BbsA = \sqrt{x^2 + y^2} = \sqrt{y^2 + \frac{4y^2y^2}{pp}}$$

$$= \frac{y}{p} \sqrt{pp + 4y^2} \quad \text{This Surd thrown into an infinite}$$

Series, will be $p + \frac{2y^2}{p} - \frac{2y^4}{p^3} + \frac{4y^6}{p^5}$, &c. and this multi-

28 ANSWERS to the last Arithmetical Questions.

multiply'd by $\frac{y}{p}$ produces $y + \frac{2y^2y}{p^2} - \frac{2y^4y}{p^4} + \frac{4y^6y}{p^6}$;

&c. the fluent of this is $y + \frac{2y^3}{3p^2} - \frac{2y^5}{5p^4} + \frac{4y^7}{7p^6}$ &c.

now instead of p substitute its equal $\frac{y^2}{x}$ and the Series

will become $y + \frac{2x^2}{3y} - \frac{2x^4}{5y^3} + \frac{4x^6}{7y^5}$ &c. = d . But

y being known, put $m = \frac{2}{3y}$; $n = \frac{2}{5y^3}$; $\frac{4}{7y^5}$;

$q = d - y$. And then $mx^2 - nx^4 + \frac{4x^6}{7} \&c. = q$;

and by Reversion of Series $x^2 = \frac{q}{m} + \frac{nq^2}{m^3} - \frac{ms + 2n^2}{m^5} q^3$

&c. = 1294. + &c. consequently $x = \sqrt{1294.} = 35.98$ Inches = AD. and now the Altitude and

Diameter of the Base being known, the Solidity is easily found to be 361912.32 Cubic Inches = 1283.4

Ale Gallons. (a Parabolic Conoid being equal to half its circumscribing Cylinder as is thus demonstrated,

(In Fig. 14) Let AD = x ; BD = y ; a = Parameter: d =

.7854; The Area BCD describes by its Revolution is =

$4dy^2$; this multiplied by x gives the Fluxion of the Solid

BACDB = $4dy^2x$ But by the Property of the Para-

bola $ax = yy$; and $ax = 2yy$; and $x = \frac{2yy}{a}$ Ergo

$\frac{8dy^3y}{a}$ = Fluxion of the Solid, its Fluent is $\frac{2dy^4}{a}$ Re-

store now again the Value of $a = \frac{y^2}{x}$; and it will be =

$2dy^2x$; but it's evident the Content of the Cylinder is =

$4dy^2x$; Consequently the Parabolic Conoid is equal to half

its circumscribing Cylinder. Q. E. D.

QUESTION the 14th, answered by R. F.

Put AP = x ; PM = y ; AD = AF = u ; AE = AG = z ;
FP = $u - x$; FD = $2u$; GP = $x - z$; GE = $2z$; and the Para-
meter

ANSWERS to the last Arithmetical Questions. 19

meter of the Parabola $= b$; Then is $BD = \sqrt{bu}$; $CE = \sqrt{bz}$, by the Property of the Parabola.

Then by similar Triangles we have these Proportions.

$$1 \quad u - x : y :: 2u : \sqrt{bu}; u^2 - 2xu - \frac{4y^2u}{b} + x^2 = 0$$

$$2 \quad x - z : y :: 2z : \sqrt{bz}; z^2 - 2xz - \frac{4y^2z}{b} + x^2 = 0$$

$$3 \quad u - x : y :: y : x - z; y^2 + x^2 = xu + xz - zu$$

$$4 \quad \text{Substitute } u = -2x - \frac{4y^2}{b} \text{ and Then}$$

$$5 \quad u^2 - nu + x^2 = z^2 - nz + xz. \text{ Thence}$$

$$6 \quad u^2 - z^2 = nu - nz; \text{ divide this by } u - z \text{ and}$$

$$7 \quad u + z = n; u = n - z; u^2 = nu - zu.$$

$$8 \quad u^2 = nu - x^2 = nu - zu. \text{ Consequently}$$

$$9 \quad zu = x^2 \text{ Substitute in the 3d Step for } zu \text{ its}$$

$$\text{Value found in the 6th Step, and we have}$$

$$10 \quad y^2 + x^2 = xn - xz + xz - x^2, \text{ Or } y^2 + 2x^2 = xn$$

$$\text{Restore again the Value of } n, \text{ and it is}$$

$$11 \quad y^2 + 2x^2 = 2x^2 + \frac{4xy^2}{b}; \text{ Or } y^2 = \frac{4xy^2}{b}$$

$$12 \quad by^2 = 4xy^2; b = 4x; \text{ and } x = \frac{1}{4}b$$

Which is the Property of a streight Line, and shews that if you assume $AP = \frac{1}{4}$ the Parameter of the given Parabola, and erect the indefinite Perpendicular PS , it will be the *Locus* of all the Points where the two Tangents do form a right Angle, Q. E. I.

E R R A T A.

IN the last Book for APRIL, MAY and JUNE, Page the 20th, Line the 24th, instead of

$$S, \angle APG = \frac{ba - bx + cx \times \sqrt{b^2 + x^2}}{bb}$$

Read

$$S \angle APG = \frac{ba - bx + cx}{\sqrt{c^2 + a^2 - 2ax + x^2} \times \sqrt{b^2 + x^2}}$$

D 3

and

and by Multiplication and Substitution.

$$\frac{m - nx}{\sqrt{x^4 - px^3 + qx^2 - rx + s}} = \text{Sine of the Angle APG}$$

In Fluxions — $\dot{n}x \times \sqrt{x^4 - px^3 + qx^2 - rx + s}$ subtracting
from it $4x^3\dot{x} - 3px^2\dot{x} + 2qxx - r\dot{x} \times m - nx$

$$2\sqrt{x^4 - px^3 + qx^2 - rx + s} = 0$$

Hence — $2nxx^4 - px^3 + qx^2 - rx + s = m - nx \times 4x^3 - 3px^2 + 2qx - r$; which will only produce an Equation of the 4th Power, in which $x = 9.22$ as before.



New ENIGMAS to be answered.

(1.) ENIGMA the 11th, by J. T.

FROM Heterogeneous Parents, I my Birth
Derive : From Water Part, and Part from Earth.
What Country first produc'd me, is unknown ;
But now through *Europe* I'm familiar grown.
It is my daily and peculiar Care;
T' improve the charming Graces of the Fair :
From outward Harms to guard their tender Frame,
Therefore a Share in their Esteem I claim.
Sometimes I strive to regulate the Stature,
And to supply th' unkind Defects of Nature ;
But where I exercise co-ercive Force,
Most commonly I make the Matter worse.
At Balls, at Plays, and on each Holyday,
I love t' appear in Habits rich and gay ;
And of my Faithfulness can justly boast.
For without Leave I ne'er forsake my Post.
Yet notwithstanding this, when aged grown,
I with ungrateful Scorn aside am thrown.

(2.) ENIGMA the 11th, by I. H. M.

WE are a num'rous, but a thoughtless Race,
Fam'd for insulting Aïrs, and Brazen Face ;
Prone to believe and spread malicious Lies,
And our Superiors haughtily despise :
Strangers to Gratitude and Reason's Law,
And are most useful when we're kept in Awe.
In several Parts of *Europe* we are found,
But in *Great-Britain's* fertile Soil abound :
Through her fair Cities such Confusions spread,
As touch the most Heroic Souls with Dread,
And strike the fainting Female Sex half dead.
For long Experience proves, when we are Masters
Our Reign's attended with most sad Disasters.
As in a Town seiz'd with a raging Fire,
Whose furious Flames swift to the Clouds aspire,
The Air resounds with universal Cries,
Whilst all Efforts the conqu'ring Blaze defies :
So we, when headstrong and unruly grown,
All Human and Divine Commands disown ;

The

The Rage of domineering Fire resemble,
 And sometimes make the greatest Princes tremble.
 But as that Element kept in its Station
 Is highly beneficial to each Nation;
 So we, when moving in our proper Sphere,
 The great Support of Trade and Riches are.

(3.) ENIGMA *the Thirteenth, by the same.*

BRED in dark melancholy Shades below,
 To Sun-burnt Climates my Descent I owe
 But, by th' Improvements Art in me has made,
 Such shining Excellencies are display'd
 That the most beauteous celebrated Toast
 The like attracting Charms can scarcely boast
 And, what's most strange, but yet a certain Truth,
 My Beauty blooms as fresh in Age as Youth.
 With Pearls and costly Diamonds attird
 By Persons of High Birth I am admir'd
 And, though by grave Philosophers despis'd,
 By mighty Kings I have been idoliz'd.
 The Footsteps of mine Ancient Origin,
 May be trac'd up as high as *Nimrod's* Reign;
 Howe'er in *Abraham's* Time I was well known,
 As may from Sacred History be shown.
 When *Solomon* sat on his Glorious Throne,
 My Charms with such enchanting Lustre shone,
 That, spite of all his beauteous Wives Perfection,
 I gain'd th' ascendant Place in his Affections.
 Ev'n Length of Time, which most Things else devours,
 Doth not diminish mine attractive Powers:
 I still can boast as large a Train as ever
 Of Votaries, that humbly court my Favour;
 And, fir'd with amorous Passion, for my Sake,
 Their Lives and Fortunes sometimes rashly stake.
 Though, to speak Truth, I'm but an 'Outside Show,
 And promise what I never can bestow;
 My close Embraces I vouchsafe to few,
 And some of those unworthy of them too.

(4.) ENIGMA

(4.) ENIGMA *the 14th*, by ENIGMATICUS.

WE are all bonny Mettle Blades,
And arrant Sharpers by our Trades ;
Yet few by us great Sufferers are,
Unless for want of prudent Care :
In populous and wealthy Places,
We take Delight to show our Faces :
And when our nimble Pranks we play,
Most commonly we clear the Way.
We frequently at Court appear,
And then a costly Garb we wear ;
But when in humbler Mansions seen,
We covet to be plain and clean :
A richer, or a meaner Dress,
Adds nothing to our Usefulness.
At private and at publick Feasts,
We always are most welcome Guests :
And when by Masters costly Care,
The Table's spread with choicest Fare,
To us they such a Deference pay,
That all the Company must stay,
'Till we fall on, and lead the Way.
But all this Kindness they pretend,
Is but to serve a selfish End :
For when the long Repast is done,
They bid us haughtily be gone :
We presently our Posts resign,
Nor at such Usage e'er repine.

}

(5.) ENIGMA *the 15th*, by OEDIPUS ESORACENSIS.

WHEN by Almighty Sov'reign Pow'r display'd,
The strong Foundations of the Earth were laid ;
And *Chaos*, where Confusion long had reign'd,
A regular and beauteous Form obtain'd :
Then we sprung up, by bounteous Heav'n design'd
As Chief, peculiar Blessings to Mankind,
Amongst those many, which, for Human Use,
Th' invigorated Earth spontaneous did produce.
Our Stature's small, but pleasing to the Sight,
All Sects and Parties in our Praise unite,
And in our flourishing Estate delight.

}

The greatest Kings our daily Aid require,
 And conqu'ring Armies faint when we retire.
 Th' Extinction of our Species to prevent,
 We to a Prison dark and cold are sent,
 Where, after having laid some Time confin'd,
 We die, and thereby propagate our Kind.
 Therefore by Persons of Divine Reflection,
 We're stiled Emblems of the Resurrection.
 No sooner is our tender Brood disclos'd,
 Than 'tis to threatening Enemies expos'd ;
 And is by them so constantly pursu'd,
 As if they had its early Ruin vow'd :
 Arriv'd at last unto a perfect Age,
 More num'rous Foes against our Peace engage ;
 And from all Quarters daily us annoy,
 As if our Race they purpos'd to destroy ;
 'Till by our neighb'ring Friends united Aid,
 We to defensive Mansions are convey'd :
 Our Gratitude we chearfully express,
 When e'er we can relieve them in Distress,
 Suffer for them the severest Punishment,
 The most enraged Malice can invent :
 Are often most unmercifully beat,
 Endure the tort'ring Rack, and scorching Heat ;
 Yea, to preserve their Lives, we lose our own :
 Such grateful Instances are seldom known.

(6.) ENIGMA the 16th, by J. T.

MY Complexion is black, and good Features I lack,
 Nor have Reason to boast of my Stature ;
 And for a long while, I have serv'd as a Foil
 To the lovely Perfections of Nature.
 The Time of my Birth, and what Cause brought me forth,
 Are Secrets I care not to mention ;
 But as soon as in Town, I was publicly known,
 And prov'd a great Bone of Contention.
 The grave Dons did not fail, against me to rail,
 Old Matrons did likewise abuse me ;
 And, for a long Time, it was counted a Crime
 Ev'n with Moderation to use me.
 This made me essay, to find out some Way,
 To screen me from Scorn and Reflection ;
 And therefore to Court, I got Leave to resort,
 Which seem'd a sufficient Protection.

This

This help'd me t' oppose, my turbulent Foes,
 And gave me no small Reputation :
 Thus from Scandal releas'd, I was highly carels'd
 In all the gay Parts of the Nation,
 By such crafty Ways, my Fame I did raise,
 And so far the Fair Sex deludett,
 That, with impudent Face, (as if void of all Grace)
 I ev'n into Churches intruded.
 My wanton Behaviour, could hope for no Favour,
 Whilst in such an hallowed Place,
 For Divines did not spare, with Zeal to declare,
 That I was one of *Lucifer's* Race.
 But, in Spite of Address, from Pulpit and Press,
 New Proselytes daily I gain'd,
 'Till I got such an Head, that mine Enemies fled,
 And I long triumphant remain'd.
 But all Things have their Fate, in this mutable State,
 (As by sad Experience I find)
 For within these late Years, it plainly appears,
 The Force of my Charms hath declin'd.
 Yet some Ladies polite, still in me take Delight,
 Nor to pay Visits with me disdain ;
 And I'm apt to presage, that in the next Age,
 I shall my lost Glory regain.



New Mathematical QUESTIONS to be answered.

(1.) QUESTION the 29th, by J. T.

OLD *Homer* doth in his first *Iliad* shew,
How *JUPITER*, inrag'd at *Vulcan*, threw
Him with resistless Might from Heav'n to Earth,
And (as the History thereof sets forth)
On *Lemnos* Isle he fell ; in which Descent,
A Summer's Day, or sixteen Hours, were spent :
Supposing that he did accelerate,
As Heavy Bodies do (in the like State)
Near to the Surface of our Earth ; pray tell
What was the Number of the Miles he fell,
In the last Second ? And likewise how high
Above the Earth, this Heaven was, descry.

(2.) QUESTION the 30th, by R. G.

TWO Masons A and B jointly finished a Piece of Work
in 12 Days ; but had each finish'd it alone, then (A
having quicker Hands) the Rectangle of A's into B's
Days added to the Square of A's Days will make 1000.
Required the Number of Days, in which each Man could
finish it alone.

(3.) QUESTION the 31st, by R. P.

A Number of young Men and Maidens neat,
One Evening met together at a Treat,
Where mutual Mirth was mixt with costly Chear,
Until an heavy Charge brought up the Rear :
The Landlord, having drawn up his Account,
To Fifty Shillings it did just amount :
And as the Case admitted no Delay,
On these Conditions all agreed to pay :
Each Man to pay a Sum I shall not name,
And every Maid the Square Root of the same.
Now had the Number of these sprightly Maids
Equall'd the Number of the jovial Blades,
And each had paid the first appointed Sum,
Unto Four Shillings less the Reck'ning would have come.

The

New Mathematical Questions, to be answered. 37

The Men likewise in Number did exceed
The Maids, by just the Sum that was agreed,
By every of the Men to be defray'd
More than was chargeable on each young Maid.
Pray tell me (if it be within your Reach)
Precisely what the Numbers were of each.

(4.) *QUESTION the 32d, by J. T.*

THERE is given in a plain Triangle, the Base equal to 60 Yards, and the Difference of the other two Sides equal, to 10 Yards, and the Area of the Triangle equal to 990 Yards : Required to find the Sides separately, and to construct the same Geometrically.

(5.) *QUESTION the 33d, by I. T.*

IN a certain Northern Latitude, on Board of a Ship at Sea, the Sun's Altitude, when due West, was observ'd

to be $29 : 32$; and afterwards the same Day at Six a

Clock his Altitude was found to be $18 : 49$ required the Latitude of the Place where, and the Declination of the Sun when, these Observations were made.

(6.) *QUESTION the 34th, by J. N.*

UPON the Coast of Kent stand a Church and a Tower, whose Distance from each other is known to be 20 Miles : A Ship at Anchor sees a Windmill in a right Line with the Tower, they bearing from her N. W. by W. and the Church then bore N. W. by N. $\frac{1}{4}$ Northerly. After this she weighs Anchor, and sails upon a W. and by N. Course 25 Miles; and then finds the Mill and Church in a Line bearing from her N. E. and by N. Required the Distance of the Ship from the Church and Tower, and Windmill, in both Stations.

(7.) *QUESTION the 35th, by J. T.*

IN Georgia's thinly peopled Continent,
Lands may be purchas'd, of a large Extent,
For trifling Sums, compar'd to what are paid
In Countries that abound in Wealth and Trade :
There, a *Salisburyer*, at an easy Rate,
(Twelve Pence *per Acre*) purchas'd an Estate :

The

38 *New Mathematical Questions to be answered.*

The *Indian* Chief, who sold it, did agree
 The Form thereof triangular should be.
 One Side of the fore-mention'd Tract of Ground,
 By nice Survey, Seven Hundred Yards was found ;
 Nine Hundred Fifty Yards did just decide,
 The Length appointed for the other Side :
 How many Yards the third Side must contain,
 I now desire you would to me explain :
 And in such manner, that the honest Man,
 Get as much Ground as possibly he can.
 Make the Triangle's Area such a Sum
 Of superficial Yards as is a MAXIMUM.

(8.) QUESTION *the 36th, by R. F.*

GIVEN the AREA of the Parabolic SEGMENT
 ABHCDA = 154 Square Perches, (*Vid. Fig. 16.*)
 as also the Line AD subtending the same = 24 Perches.
 To find the greatest Trapezia that can be inscribed in the
 said Parabolic Segment, whose Side BC may be parallel
 to AD.

(9.) QUESTION *the 37th, by J. F.*

THOSE, who on Conic-Sections treat,
 Distinguish them (as it is meet)
 By the Equations which express the same
 One a Parabola they name :
 To form this, you must cut the Cone,
 By a plain Parallel to One
 O' th' Sides : But as Parabola's
 May differ in their Area's,
 Though out of the same Cone they're cut,
 I shall the following Question put :
 Which of them is the Greatest pray
 Declare, and what its Area,
 When the Cone's Side is twenty Feet,
 Its Base's Radius twelve compleat.

(10.) QUESTION *the 38th, by J. T.*

IT is required to find a Curve, whose indefinite Qua-
 drature is expressed by $\frac{x^3}{4}$

(11.) QUESTION

(11.) QUESTION the 39th, by the same. *d*

LET a heavy Body be projected in an Angle of $32:00$ Elevation above the Horizon, and let its Amplitude (or the Distance of the Place, where it will fall upon the Ground from the Place of its Projection) be 2400 Yards; it is required to determine the greatest Altitude, to which it will ascend.

(12.) QUESTION the 40th, by R. F. *d*

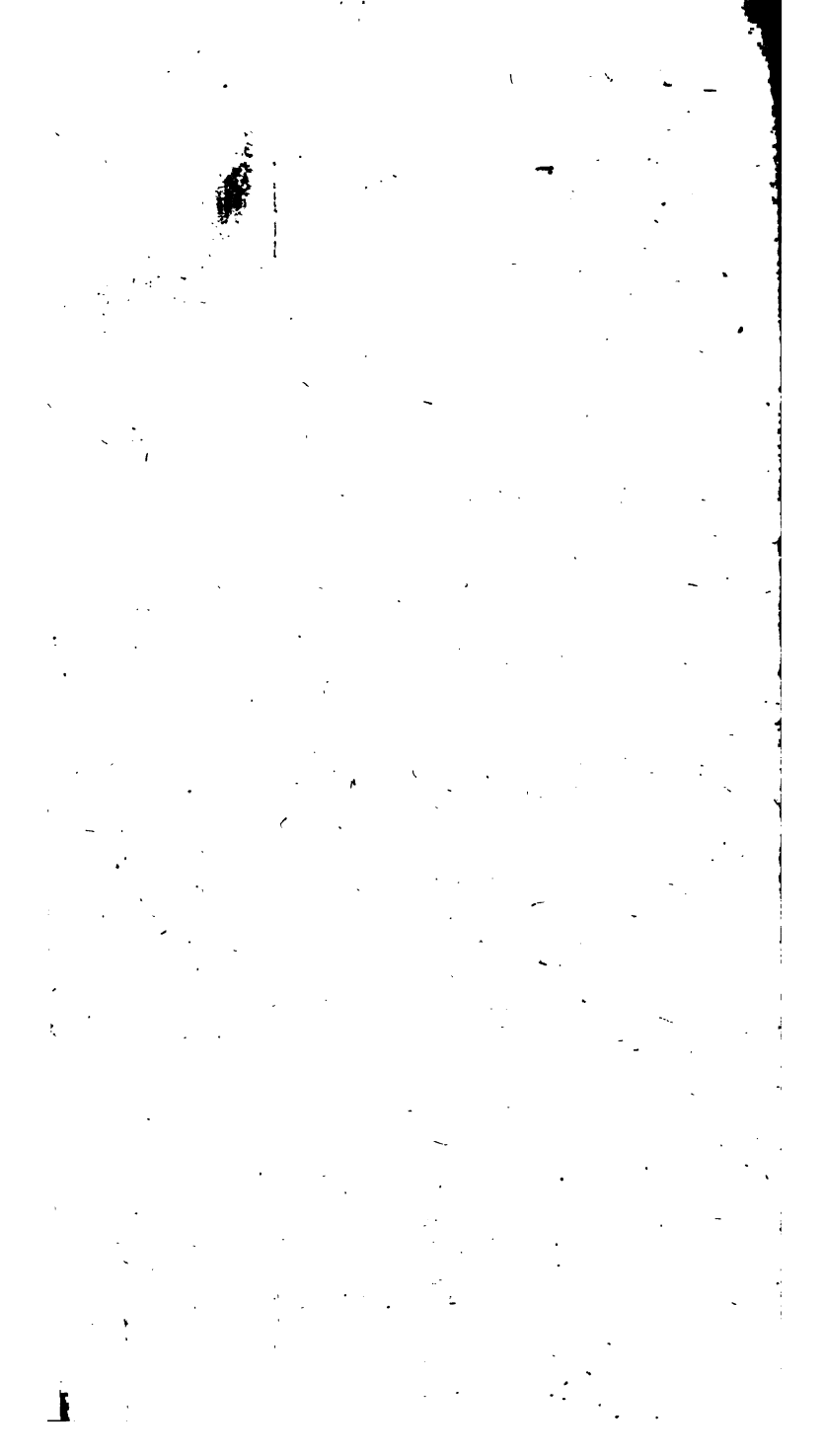
AN Angle $GAH = 45^{\circ} 00'$ (*Vide Fig. 18.*) and a fixed Point B in one of the Sides AH being given; if from the Point B there be drawn the right Line BC perpendicular to AH, and from any Point P the right Line PE parallel to BC, meeting AG in E; and upon the Centre B, with the Radius PE, we describe an Arch of a Circle, which cuts PE in M; and as an infinite Number of Points such as M may be found after this Manner, it is required to find a Curve which is the *Locus* of them all.

(13.) QUESTION the 41st, by J. T.

SUPPOSE there be a Piece of Ground in Form of a Parabola, which includes another that is a perfect equilateral Triangle; one of the Sides of which is an Ordinate rightly apply'd to its principal Axis; and the other two Sides meet in the Focus of the Parabola, which is their angular Point: The Area of the Triangle is given, viz. 500.564 Square Yards. Required the Area of the Parabola.

(14.) QUESTION the 42d, by J. T.

HOW few I among the Multitude, that strive
To find out Truth, can at the Point arrive;
Though Knowledge they thro' rugged Paths pursue,
And ev'ry Day the studious Toil renew.
Yet He that will (without a partial Sway)
Nicely the sev'ral Sciences survey,
Must own the *Mathematicks* are the surest Way.
Among the Antients, those of greatest Fame,
And Station too, did cultivate the same:
To their industrious and sagacious Care,
The several Ages since indebted are:
For they the Grounds and Principles laid down,
By which succeeding Times have wiser grown.



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For the MONTHS of JANUARY,
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T H E P R E F A C E.

 O *****

NE would think that the Mathematick Arts need no Encomiums to recommend them to the World, but that they would be readily entertain'd and embraced by all who have Leisure and Opportunity to get acquainted with so useful a Part of Humane Learning: It must be confess'd by all, that no Humane Knowledge whatsoever, can lay a more just Claim to an unshaken Evidence and Certainty, or boast an higher Necessity of its Demonstrations, or a greater Multitude of undeniable Truths, than the Mathematicks: So that Mr. LOCKE, did not without Reason say, That he could wish Persons were more generally acquainted with 'em, not so much to make them Mathematicians, as to make them reasonable Creatures.

Various and great are the Advantages which accrue to Mankind from this Science. One (not the least) of which, is the Knowledge of the true Figure of our own terrestrial Habitation. Divers of the Antients, and particularly LACTANTIUS, and some Others of the 'Primitive Fathers, supposed the Figure of our World to be a large extended Circular Plain, founded upon a Basis or Pedestal continued infinitely downwards. ANAXIMANDER, the Philosopher, supposed it to be Cylindrical like a Drum. But our modern Philosophers and Mathematicians do universally agree, that it is Globular or Spherical, which may be thus proved. The Shadow of the Earth (in every Lunar Eclipse, in whatsoever Position it be) projected to the MOON appears Circular, from whence it necessarily follows

that the Earth from whence this Shadow proceeds, must be every Way Circular, that is Spherical.

But perhaps some may object that the Section of Light and Shadow in Lunar Eclipses is not caused by the Umbra of the Earth, but by that of its Atmosphere; and that we can only infer from hence the Sphericity of the Earth's Atmosphere. But then it is to be observed, that the Atmosphere of the Earth in every Part of the World appears a Spherical Concave; and therefore, that the Earth, which is in all Places alike encompassed by it, must be Spherico-Convex.

I omit here the Consideration of the small Difference between the Equatorial and Polar Diameters arising from the Centrifugal Force, which is inconsiderable in Respect of the whole Diameter of the Earth.

Besides, another Argument to prove the Spherical Figure of the Earth may be drawn from hence, that when we Travel from North to South, the Pole is depressed exactly in such Proportion, as the Figure of the Earth (if Spherical) would Require.

Again, The Spherical Figure of the Earth is also certainly concluded from the Perpendicular Descent of all heavy Bodies. For it is evidently manifest, and what hath been alike observed in all Regions whatsoever, that heavy Bodies when lifted up, do fall down to the Surface of the Earth, in lines perpendicular thereto, or which is the same Thing, to its Horizon, which is an irrefragable Proof of the Proposition: Since, as in all plain Figures, none can have its Perimeter every where perpendicular to the Radius, but a Circle; so, none amongst Solids, but a Sphere, can have its Surface, or Horizon, perpetually and every where perpendicular to its Diameter.

The Spherical Figure of the Earth, may likewise be deduced from several other Phenomena; but what I have mention'd are sufficient, so shall not take up any more of my Readers Time therewith.

MARCH the 25th, 1733.

A D V E R.



ADVERTISEMENT To all LOVERS of INGENUITY.

THE Author intending to publish the next Quarterly Book in JUNE ensuing, desires that such Gentlemen and Ladies, &c. as think fit to encourage this Undertaking, either by promoting and recommending the Sale thereof, or by sending such Subjects either in Verse or Prose, as are suitable to this Design, would please to direct their Letters to Mr. THO. GENT, Printer, near the Star in Stone-Gate, YORK, Post paid, before the End of May next, where they will be carefully forwarded to the Author.

Whoever send either Enigmas, or Arithmetical Questions, are desired to give the Solution along with them, to prevent all Mistakes, or Ambiguity in the Terms: And I do assure the Buyers of this Treatise, that, in Process of Time, they shall have Questions in all the Branches of Mathematicks, viz. Arithmetical, Nautical, Geographical, Mechanical, Trigonometrical, Astronomical, Algebraical, and in Fluxions, together with exponential Equations, and the Construction of Algebraic Equations, and finding their Loci; to suit the Tastes of all Persons, and render the Work generally useful.

Omne tulit punctum, qui miscuit utile dulci.



Miscellanea



Miscellanea Curiosa, &c.



DEFINITIONS *Preparatory* to MATHEMATICAL PHILOSOPHY.



CENTRIPETAL Force is that, whereby a Body is drawn, impell'd, or in some Way or other tends to a Centre.

OF this Sort is Gravity, whereby a Body tends to the Centre of the Earth ; the Force Magnetic, or that whereby Iron tends to the Centre of the Loadstone ; the attraction or stretching of the Cord to retain the Stone that is whirl'd round in a Sling. Hither also is to be refer'd that Force, whatsoever it is, whereby the Planets are continually held back from rectilineal Motions, and compell'd to revolve in Curvilinear ones. The Quantity of this Centripetal Force, is of three Sorts, viz. absolute, accelerating, and moving.

THE absolute Quantity of the Centripetal Force, is the Measure of the same, greater or lesser, according to the Efficacy of the Central Cause, which propagates it from the Centre all round about. Thus the Strength of Magnets is different, and greater *ceteris paribus*, in the greater Magnet, and lesser in the less. The attraction or retention of the Cord greater in the Circumvolution of a greater Stone, than in that of a less ; and in the swifter Circumrotation of the same Stone, than in a slower ; and thus

thus we may conceive, that the Gravitation of Bodies to the Sun, which is a Body so much greater than the Earth, is greater at an equal Distance than the same is towards the Earth.

THE accelerating Quantity of the Centripetal Force is the Measure of it in divers Distances from the same Centre ; which is proportional to the Velocity which it produceth in a given Time.

As the Virtue of one and the same Magnet (in which consequently the absolute Quantity remains the same) is greater in a less Distance than in a greater ; the gravitating Force on the Surface of the Earth, is something greater about the Poles than about the Equator. It is greater also near the Surface of the Earth, than at a greater Distance from the Centre. But this accelerating Force (which is distinctly to be noted) is at equal Distances from the Centre every where the same, and this in all Bodies, whether they be heavy or light, great or small, solid or fluid : That is to say, if you do here abstract from the Resistance of the Air. Which Thing is proved by the equally swift Descent of all falling Bodies in Tubes emptyed of Air ; and from the Motion of all Pendulums, of what Matter or Magnitude soever, vibrating together in like Circles or Cycloids.

THE moving Quantity of the Centripetal Force, is the Measure of the same, proportional to the Motion, which it generates, in a given Time.

THIS Force is the Propension of the whole Body towards the Centre, which is estimated by the Quantity of the Force contrary thereto, which is required to the hindering its Descent, which is called the Weight of the Body, and is greater in a Body which is greater ; and greater in the same Body, by how much it is nearer to the Earth. The absolute Quantity therefore, of the Force we are treating of, is defined from the Magnitude, or at least from the Strength and Efficacy of the Central Body. The Accelerating is that Force as perpetually decreasing in the Increase of the Distance, and on the contrary. The moving Force is the Weight itself ; which ariseth from the Body or Mass drawn into the accelerating Force. From whence the absolute Force being given, the moving Force in a given Body will be as the accelerating ;

lerating ; and the accelerating being given, it will be as the Body. These three Forces therefore are referr'd to three Things ; to Bodies, to the Places of Bodies, and to the Centre of Force. The motive Force respects the Body, and the Endeavour and Propension thereof to the Centre, as compounded of the Endeavours and Propensions of all the Parts. The accelerating refers to the Place of the Body in the *Medium*, as the Efficacy of the same absolute Force according to divers Distances from the Centre ; and the absolute Force respects the Centre, or Central Body itself, as endow'd with some Power, without which the moving Forces are not propagated round about ; whether that Power or Cause be the Central Body (as the Magnet in the Centre of the Magnetic Force, or the Earth in the Centre of the gravitating Force) or be some other Thing which doth not appear. At least, this is a Mathematical Conception, and sufficient for our present Purpose ; for we do not yet consider the Physical Causes of those Forces. The accelerating Force therefore is to the Motive, as Swiftness is to Motion ; for from the same, as multiply'd into the Quantity of the same Matter, the Moving Force arises ; like as the Quantity of Motion arises from the Celerity multiply'd into the Body. For the Sum of the Actions of the accelerating Force upon each Particle of the Body, is the moving Force of the whole ; from whence where the accelerating Gravity is the same, the moving Gravity, or Weight, is as the Body. And in the same Body where the Acceleration is diminished, as in the Upper Regions, the Weight is likewise diminished. Thus where the accelerative Force is twofold less, the Weight of a Body twofold or threefold less, will become fourfold or sixfold less. Furthermore, we call Impulses and Attractions accelerative and motive in the same Sense. And we use the Words [*attraction, impulse, and propension to a Centre,*] indifferently and promiscuously ; we at present considering these Forces not Physically but Mathematically, as was said before, and now say again, to caution our Readers from understanding us, as meaning and defining Physical Causes or Reasons of Motions, or attributing to Centres, which are Mathematical Points, true and proper Physical Force ; when at any Time we say that the Centres draw, or have Force in them.

Axioms or Laws of Motion.

1. **E**VERY Body perseveres in its own present State, whether it be that of Rest, or uniform direct Motion; unless it be compelled by some Force impress'd to change that State.

Projectiles hold on their Motion, so far as they are not hinder'd by the Resistance of the Air, or their own Gravity. A Top, whose Parts by cohering continually draw themselves from the rectilinear Motion, ceaseth not to be whirl'd about, so far as it is not retarded by the Air, or the unevenness of the Surface, on which it turns. But the greater Bodies of Planets and Comets maintain their Motions, whether Progressive or Circular, much longer in Spaces less resisting. This Law of Motion is indeed the fundamental Law of all, and is most evident from the merely Passive Nature of Matter; which makes it naturally as impossible for a Body of it self to stop its own Motion once begun, as it is for it to move itself originally.

(2.) All Motion is of itself rectilinear.

For Motion cannot be conceived, but it must be directed and determin'd towards some Place or other, and it will by the Law foregoing keep the same Direction which it first had, until it be hinder'd or put out of its Way by some extrinsic Cause.

And consequently, whenever any Body is mov'd in a Curve, that Curvature must needs proceed from External Force; and therefore must cease when that Force ceaseth. Which, when it doth, then by this and the foregoing Law, the Motion will be continued in a right Line, which is the Tangent of the Curve, at the very Points of the said ceasing Force, or in the last Rectilineal Direction. Thus it is in a Stone wheel'd about in a Sling, which slipping out of the Sling is not now carried forward in its former Circle or any Circle at all, but in a Tangent of the former Circle; where indeed, by Reason of the Force of Gravity, compounded with the projectile Force, it describes a Parabolic Line: But of this afterwards.

(3.) All Bodies carried about, endeavour to recede from the Center of their Motion; and by how much the Motion is the swifter, this Endeavour is the greater.

For seeing Bodies do of themselves tend to a Rectilineal Motion, of that which is according to Tangents of Curves; and seeing all the Parts of the Tangents are further distant from the Center of Motion, than the Parts of the Curves, unto which the Bodies are drawn by the Centripetal Force: It is manifest, that that Endeavour of going off according to Tangents, doth as much draw back the Bodies from the Center, as the Centripetal Force draws them to it, and is exactly equal to the contrary Endeavour of the Centripetal Force.

(4.) The Mutation of Motion is proportional to the moving Force impress'd; and is according to the right Line, in which that Force is impress'd. If any Force generates any Motion, a Double Force will generate a Double one, a Treble a Treble one; and this whether the Force be impress'd all at once, or successively.

And then this Motion impress'd, (for as much as it is always determin'd to the same Part, with the generating Force) if the Body on which the Impression is, was before in Motion, either is added to the Motion thereof, as conspiring together with it; or subdued therefrom, as being contrary thereto; and thus it either increaseth, or diminisheth the former Velocity. But if the Impulse be oblique, it is added obliquely, and compounded with the former Motion, according to the Directions of both. So that if it were at right Angles, the Velocity, as considered in the first Line will neither be increas'd nor diminish'd.

(5.) Re-action is always contrary and equal to Action. That is, the Actions of Two Bodies, acting upon each other; whether they be by Impulses or Attractions, are always directed each to the contrary Part, and are also equal.

Whatsoever presseth or draweth another thing, is equally pressed or drawn thereby. If you press a Stone with your Finger, your Finger is equally press'd by the Stone. When a Horse draws a Stone tied to a Rope, the Horse will equally be drawn back to the Stone: For the Rope, which is distended on both Sides, will, with the same Endeavour

deavour of relaxing itself, draw the Horse to the Stone, as it doth the Stone to the Horse; and will so much hinder the Progress of the one, as it forwards the Progress of the other. If one Body dashing upon another, shall by its Force in any sort change the other's Motion, it will also reciprocally undergo the like Change in its Motion, to the contrary Part, by the Force of the other, and this by reason of mutual Pressure. But then by these Actions are made equal Changes; not of Velocities but Motions; to wit, in Bodies not otherwise impeded. For Mutations of Velocities made to the contrary Parts, since the Motions are equally changed, are reciprocally proportional to the Bodies: We may shew the Matter briefly thus, in Attractions. Let some Obstacle be suppos'd to be interpos'd betwixt the Bodies A and B, which attract each other, to keep them from meeting together. If either of the Bodies, as A, be more drawn towards B, than B is towards A; the Obstacle will be press'd more with the Action of A upon it, than with that of B; and consequently will not remain in an Equilibrium. The stronger Pressure therefore prevailing, will make that the System of the three Bodies will be mov'd directly unto that Part which is from A to B; and so in a free Space will be mov'd *in infinitum* in that Direction, with a Motion continually accelerated: Which is absurd and contrary to the first Law of Motion. For by that the System ought to persevere in its State, whether of Resting or moving right forwards; and consequently the Bodies will equally press the Obstacle, and so will equally be attracted to each other. And the Thing is the same if there be no Obstacle; for the stronger Motion will in the Meeting overcome the Weaker, and carry both Bodies to the same Part, and according to its own Direction. Wherefore, either there is no Attraction wth a System of Bodies where the first Law hath Place, such as the Solar one is, as we shall hereafter clearly demonstrate it to be; or the Attraction is mutual and equal. The Famous Sir *Isaac Newton* hath made an Experiment of the Matter in the Magnet and Iron. If these be separately put in two proper Vessels, swimming close to one another in a standing Water; neither will prevail over the other, but with an Equality of Attraction on both sides, they will sustain

their mutual Endeavours on one another, and at length being in Equilibrio will be at rest. So likewise, the Gravity betwixt the Earth and its Parts is mutual and equal. If the Globe of the Earth $H E F G K I$ (*Fig. 1.*) be divided into Two unequal Parts by the Plane $G E$, the Gravity of the Part $E G F$, towards the rest of the Earth, will be equal to the Gravity of the rest of the Earth towards this Part; which is proved thus. Imagine the Earth to be divided by Parallel Planes into three Parts, $E G F$, $H K I$, $E G K H$; of which $E G F$ and $H K I$ are equal to each other, and lye upon the middle Part $E G K H$. Here it will be manifest, that the middle Part $E G K H$, doth by its own Weight incline to neither of the Parts, but hangs, as we may say, in Equilibrio betwixt both, and so rests. But the Extreame Part $H K I$ lies with its whole Weight upon the middle Part, and urgeth that towards the other Extreame Part $E G F$. And therefore, the Force wherewith the Sum of the Parts $H K I$, and $E G K H$, tends towards the Third Part $E G F$, which is equal to the Weight of the same Parts, is equal to the Third Part $E G F$. And therefore if the Earth be divided by any Plane whatever, as $E G$ into Two Parts $E G F$ and $E G I$, the Force wherewith the greater Part $E G I$ tends to the lesser $E G F$ is equal to the Force wherewith the lesser Part tends to the greater; and unless those Weights were equal, the whole Earth would give Place to the greater Weight, and in yielding to it would fly away, and there would no Place be found for it; which, as before, is absurd, and contrary to the first Law.

(6.) If of two equal Bodies, void of Elasticity, one of them which is in Motion meets the other at rest, upon the meeting they will both be carried forwards together, to the same part, with half the Velocity of the Body which was moved. For the Body put in Motion, will in the Shock communicate its Motion so long to the other quiescent Body, till that moves with the same Velocity with it self. For whilst the Velocity of the mov'd Body is greater than the Velocity of that which was before quiescent, the former Body will still force the other, and accelerate its Motion; but as soon as the Body that was quiescent

quiescent hath gotten a Velocity equal to what the moving Body moves with it can force it no further, but follows it closely. And thus the Motion of the former being now equally divided betwixt them, it appears that they are both carried with half the Velocity which the former had before.

(7.) If two equal Bodies, void of Elasticity, do directly meet each other with the same Velocity, they upon the Collision will both of them rest.

For so much as either of them tends to go forward, it is repelled by the other : And so these Two equal Forces, or Quantities of Motion, tending to the contrary Parts, will destroy one another ; whereupon, there being no new Cause of Motion, they must needs both of them rest. In which Case, the Motion wholly perisheth, contrary to the Opinion of *Cartes*, who would have the same Quantity of Motion always to remain in the World.

(8.) If two unequal Bodies, destitute of Elasticity, meet one another with such Velocity, that by how much the greater exceeds the other in Magnitude, by so much it is exceeded by the lesser in Swiftnes, so that the Velocities are reciprocal to the Bodies ; they will both rest after the meeting.

For the Motions which are directly opposite to each other, being as to the Quantities of them equal, they will destroy one another, as before.

(9.) If a moving Body strike another at rest, (but both void of Elasticity) how unequal soever they be in Bulk and Quantity of Matter, they will both move after the Shock with the same Velocity towards the same Parts, as in the Sixth Law : And the common Velocity will be so much less than the first, as both the Bodies together are greater than the Body first moved. For since all the Motion of the former Body is now divided between the two Bodies, the Velocity will be so much diminished, as the Quantity of Matter to be moved is increased.

OF THE



ANSWERS to the last ENIGMAS.

- | | |
|---------------------|----------------------|
| 1. A Pair of Stays. | 4. Knives and Forks. |
| 2. The Mob. | 5. Bread-Corn. |
| 3. A Crown. | 6. A Patch. |



All the Enigmas answered by RUSTICUS.

*B*eatas illos, qui procul Negotiis,
 Ut prisca gens Mortalium
 Paterna Rura sibi exercet suis,
 Solutus omni scenore
 Neque excitatur Elastico Miles truci,
 Neque horret iratum Mare
 Forumque vitat, & superba Civium
 Potentiorum Limina.

HOR. Od. 1. Lib. 5.

HOW happy is a Country Life !
 Remote from * Mores outrageous Sense ;
 Blest with untainted vigorous Health,
 Not oft the Lot of Pride and Wealth
 The Virgin here, with strait-lac'd * Stays,
 Seldom a slender Waste essays,
 Nor e'er attempts a lovely Face,
 With Paint and * PATCHES to disgrace,
 With KNIVES and FORKS, not rich, yet neat. * 4
 We carve our wholesome plain-dress'd Meat :
 An eager Appetite, (my Friend)
 Does all our Viduals recommend.
 How pleasant in a Summer's Morn,
 To view the flow'ry Meads and * CORN ! * 5
 Whose

Whose fragrant Scents perfume the Air,
And all our vital Spirits cheer.
Wearied with Labour, or with Sport,
We to our several homes resort;
With Pleasure on our Beds lie down,
Nor envy him that wears a * Crown. * 1.

Upon the ad. Enigma, T. B. sends the following Lines.

Almighty MOB ! thou shorten'st all Dispute,
Pow'r is thy Essence, Wit thy Attribute :
Nor Faith, nor Reason, makes thee at a Stay,
Thou leap'st o'er all eternal Truths, in thy Pindarick Way.
D. D. M. D.

*Upon the Erecting King WILLIAM's
Statue at HULL.*

WHEN Popish JAMES disgrac'd the British Throne,
And Regal Pow'r to Tyranny was grown ;
When native Liberty no longer stood
The Publick Bulwark of our Private Good ;
When Papal Sway resum'd its galling Yoke,
And Antichrist the REFORMATION took ;
When these dire Ills Britannia's Bark had toss'd,
In desperate Plight her Helm and Anchor lost :
Then, NASSAU's Aid stept in, ordain'd by Fate,
To fix the Church, and prop the tot'ring State ;
His quick Dispatch and bloodless Victory prove,
His Cause was just, and favour'd from above,
Let faithful Annals gratefully record
The Trophies of this Messenger of GOD ;
Great WILLIAM's Praise exulting Britain's King
And Kingston's Sons superior Honours bring :
When JAMES's Wish, and Langdale's keener Ire,
Threaten'd her Sons with Death, her Gates with Fire ;
When ancient Guardian Bands, now turn'd to Foes,
Marshall'd in Arms, to her Destruction rose ;
When pointing Cannons, from the Tow'r brought down,
Loaded with Death, alarm'd this frightened Town ;
THEN, conqu'ring ORANGE, aided from on High,
Forbad the Gun to roar, the Balls to fly ;

On

On *British* Shores by Miracle appear'd,
 Reviv'd our Hopes, dispell'd the Ills we fear'd.
 Shall then our Hero's Worth forgotten lye,
 Lost in the Ruins of Mortality ?
 The mould'ring Grave, nor Time, a Pow'r can claim,
 To waste or bury an immortal Fame.
 Rise from thy Cell, our Great Deliv'rer ! rise,
 In this Resemblance bless our longing Eyes :
 Oh ! may this consecrated Statue be,
 As lasting as thy deathless Memory :
 Here tide in solemn Pomp, and deign to grace
 The grateful Lawrels of this rescu'd Place ;
 With Liberty the gazing World inspire,
 And each Spectators Emulation fire :
 To future Times, thou speaking Image ! prove
 With *William's* matchless Deeds, our grateful Love ;
 Tell glad Posterity, they solely owe
 The Royal Line of *BRUNSWICK* to *NASSAU*.

A Geographical Paradox or Problem.

Old Customs, tho' erroneous we find,
 Are too too oft retained by Mankind ;
 The Navigator, who has long been taught
 To use Plain-Sailing, scarcely can be brought
 To think that any other Method will
 Equal his own, much less does it excell :
 Let us for once (if lawful 'tis) essay
 To mend old Rules, and find a better Way.

TWO Places lye under the Arctic Circle ; and consequent-
 ly due East and West from each other, their Difference
 of Longitude just 100 Degrees : Now, I desire to know,
 whether there be not a nearer Way to go from the Easter-
 most to the Westernmost of them, than to steer due West,
 (as is usual amongst our Navigators when the two Places
 are under the same Parallel) and how many Miles are
 saved thereby ?

ANSWERS

ANSWERS to the last Arithmetical QUESTIONS.

QUESTION the 1st, answered by R. P.

According to the latest and most accurate Experiments, heavy Bodies fall the first Second (in our Latitude) $16\frac{1}{2}$ Feet; and in the succeeding Ones 3, 5, 7, 9, &c. Times as many Feet, or the Spaces run through, are as the Squares of the Times: Let $b = 57600$. the Number of Seconds in sixteen Hours; $c = 16\frac{1}{2}$; then $b^2c =$ the Height he fell in the whole, equal to 53360640000 Feet, which is above 1000000 Miles: Now if we put $m = 57599$. $m^2c = 53358787216$. subtract this from b^2c , and there remains 1852784. which is the Number of Feet he fell in the last Second, and amounts to 350 Miles, and 4784. Feet.

QUESTION the 2d, answered by I. N.

PUT $x =$ the Number of Days in which A could finish the Work, $y =$ the Days wherein B could finish it, then by the Tenour of the Question we shall have $\frac{1000 - x^2}{x} = y$. Now A working the faster $\frac{1000 - x^2}{x^2}$ shews the Number of Times that A finished it in B's Days, but B finished it once in the same Time: Consequently $\frac{1000 - x^2}{x^2} + 1$ shews the Number of Times they jointly did it in B's Days; thence it follows, As $\frac{1000 - x^2}{x^2} + 1 : \frac{1000 - x^2}{x} :: 1 : 12$. And multiplying Extreams and Means $-x^3 + 1000. x = 12000$. and by extracting the Root $x = 20$. the Time in which A could accomplish it alone, and $y = 30$. Days, B's Time. Q. E. I.

QUESTION the 3d, answered by W. W.

PUT $a =$ Numb. of young Men. } $u =$ what each Wom. pd.
 $e =$ Number of Women. } $u^2 =$ what each Man pd.
 $b = 46$; $c = 50$. } Then by the Question,
C. 11

$$\begin{array}{ll}
 1 & au^2 + eu = c; \\
 2 & eu^2 + au = b; \\
 3 & a - e = u^2 - u; \text{ Ergo } u = u^2 - u + e \\
 & \text{in the first and second Steps for } a \text{ substitute its Value, and we have} \\
 \text{1. by Subst.} & 4 \quad u^4 - u^3 + u^2e + ue = c. \\
 & 5 \quad u^2e + u^3 - u^2 + ue = b. \\
 \text{5 transpos'd.} & 6 \quad u^2e + ue = b + u^2 - u^3. \\
 6 \div u^2 + u & 7 \quad e = \frac{b + u^2 - u^3}{u^2 + u}.
 \end{array}$$

In the fifth Step for e put its Value, and then

$$\begin{array}{ll}
 8 & u^4 - u^3 + b + u^2 - u^3 = c; \\
 \text{8 transpos'd.} & 9 \quad u^4 - 2u^3 + u^2 = c - b;
 \end{array}$$

and by converging Series u will be found $= 2$, $u^2 = 4$, a (equal Number of young Men) $= 9$. e (Number of Women) $= 17$.

QUESTION the 4th, answered by I. N.

IN Fig. 2d.) Put $AB = 60 = b$; $AE = 10. = c$; $GB = a$; $GA = a + c$; $q = 990$. Then as $b : 2a + c :: c : \frac{c^2 + 2ca}{b}$ = difference of the Segments of the Base :

$$\text{Ergo } AS = \frac{b^2 + c^2 + 2ca}{2b}; \quad BS = \frac{b^2 - c^2 - 2ca}{2b}. \quad \text{Put}$$

$$\frac{b^2 - c^2}{2b} = m; \quad \text{and} \quad \frac{2c}{2b} = n; \quad \sqrt{a^2 - m^2 + 2mna - n^2 a^2}$$

$$= GS, \text{ by the Forty Seventh PROP. I. of EVG. And } \frac{b}{2}$$

$\times \sqrt{a^2 - m^2 + 2mna - n^2 a^2} = q$; and by Involution and Transposition, we have the following Equation

$$1 - n^2 a^2 + 2mna = \frac{4q^2}{b^2} + m^2. \quad a = 39.79 \text{ Yards, the}$$

other Side 49.79 Yards. Q. E. I.

GEOMETRICAL CONSTRUCTION.

DIVIDE the Given Area by half the Base, it will give the perpendicular Altitude of the Triangle $= 33$. Then draw GO parallel to AB at that Distance, and its Evident

Evident the Vertex of the Triangle will be some where in that Line; from B erect the Perpendicular BD, and it will also be the same to GQ, upon the Centre A with the Radius AC = 10. describe the Circle CEF: Then let another Circle BED be described touching the former Circle CEF, and passing thro' the Points B and D by Problem the 39th, Page the 145th, of Sir Isaac NEWTON'S *Arithmetica Universalis*, (which Point D will be given, because every Circle whose Centre is in the Line GQ, perpendicular to BD, will cut off a right Sine DO = BQ) the Centre of the Circle G will be the Vertex of the Triangle.

QUESTION the 5th, answered by I. T.

PUT b = Natural Sine of the Sun's Altitude at 6 a Clock = .32254; d = Natural Sine of his Altitude when due West = .49293; x = Natural Sine of his Declination, Radius = Unity, Then in the Triangle CnO,

(Fig. 3d.) we shall have, As $d : 1 :: x : \frac{x}{d}$ = Natural Sine of the Latitude of the Place, and in the Triangle CpO. As

$x : 1 :: b : \frac{b}{x}$ = Natural Sine of the Latitude, consequently

$$\frac{b}{x} = \frac{x}{d}; \text{ and } x^2 = bd; \text{ and } x = \sqrt{bd} = .39874 = 23 :$$

30; so that it's plain, in the present Case, we have no more to do, but to add the Logarithmical Sine of the two Altitudes together, and take the half of that Sum, and it will be the Logarithmical Sine of the Sun's Declination North: And hence also the Latitude of the Place is found to be

$$.80894 = 54 : 30 \text{ North.}$$

QUESTION the 6th, answered by W. W.

(In Fig. 4.) Let S represent the Ship in her first Station, H in the Second Station, C the Church, T the Tower, and M the Wind-Mill; then will the Line SMT, cut HC at Right Angles in M: And we shall have given in
C 2 the

20 ANSWERS to the last Arithmetical Questions.

the Triangle SMH , $SH = 29$ Miles, and the Angles $\overset{d}{S}HM \overset{d}{MS}H = 67 : 30$ and $22 : 30$ to find $HM = 9.6$ and $SM = 23.2$.

In the Triangle SMC are given $SM = 23.2$. and the Angles $\overset{d}{SC}M, \overset{d}{MS}C = 61 : 43$ and $28 : 7$ to find $CM = 12.4$ and $SC = 26.2$.

In the Triangle TCM are given $TC = 20$, and $CM = 12.4$, to find $TM = 15.7$ Miles.

Lastly, in the Triangle HMT , are given $TM = 15.7$, and $HM = 9.6$ to find $HT = 18.4$.

So the several Distances are as under-mentioned, viz.

From the Ship	$\left\{ \begin{array}{l} \text{to the Wind-Mill} \\ \text{to the Church} \\ \text{to the Tower} \end{array} \right.$	$\left\{ \begin{array}{l} \text{in the 1st Station} \\ \\ \end{array} \right.$	$\left\{ \begin{array}{l} 23.2 \\ 26.2 \\ 38.9 \end{array} \right.$
From the Ship	$\left\{ \begin{array}{l} \text{to the Wind-Mill} \\ \text{to the Church} \\ \text{to the Tower} \end{array} \right.$	$\left\{ \begin{array}{l} \text{in the 2d Station} \\ \\ \end{array} \right.$	$\left\{ \begin{array}{l} 9.6 \\ 22.0 \\ 18.4 \end{array} \right.$

From the Mill to the Tower 15.7

From the Mill to the Church 12.4

QUESTION the 7th, answered by F. B.

LET $AB = 950. = b$; $BC = 700. = c$; $AC = x$; (as in Fig. the 5th.) Then by what is demonstrated in Page the 140th, Vol. the 3d of Ozanam's *Cursus*.

$\sqrt{\frac{b+c+x}{2}} \times \sqrt{\frac{b+c-x}{2}} \times \sqrt{\frac{c+x-b}{2}} \times \sqrt{\frac{b+x-c}{2}}$ is equal to

The Area of the Triangle. That is,

$\frac{x}{4} \sqrt{2b^2x^2 + 2c^2x^2 + 2c^2b^2 - c^4 - b^4 - x^4} = \text{Area.}$

Now this by the Question is to be a Maximum.

Consequently $4b^2xx + 4c^2xx - 4x^3x = 0$

Divide all the Terms by $4xx$ and we have $b^2 + c^2 - x^2 = 0$;

Or $x = \sqrt{b^2 + c^2} = 1180$. Yards. And now it appears, that the Angle B, which is opposite to the unknown Side, must always be a Right-Angle.

QUESTION the 8th, answered by I. T.

DRAW the Line EH (in Fig. 6.) so as to divide AD and BC into two equal Parts, and putting $a = 154$; $b = 24$; $BC = y$; $GF = x$; By the Property of the Parabola we have

have As $b^2 - y^2 : b^2 :: LE : EH :: x : FH = \frac{b^2 x}{b^2 - y^2}$. Also

by the Property of the Curve $\frac{2b^3 x}{3b^2 - 3y^2} = a$; Ergo $x =$

$\frac{3b^2 a - 3ay^2}{2b^3}$. But it's evident, that $\frac{bx + xy}{2}$ is equal to

the Area of the Trapezium ABCD, which by the Question is to be a Maximum, substitute now the Value of x before found in this Equation, and

$\frac{3b^3 a - 3bay^2 + 3b^2 ay - 3ay^3}{4bbb} = \text{Area : In Fluxions } 3b^2 ay -$

$6bayy - 9ay^2 y = 0$ Divide all the Terms by $9ay$ and we have by Transposition $y^2 + \frac{2}{3}by = \frac{1}{3}bb$. $y = \sqrt{\frac{1}{3}b^2 + \frac{2}{3}b^2} = \frac{1}{3}b (= \frac{1}{3}b) = 8$. Consequently $x = 8$. 5555 &c. and the Area of the greatest Trapezium is $= 136.888$, &c.

Q. E. F.

QUESTION the 9th, answered by I. N.

L Et the Side of the Cone $BD = 20. = b$;
The Base $AD \dots \dots \dots = 24. = c$;
 $CD = CH \dots \dots \dots = x$;

Fig. the 7th.

Then by similar Triangles, As $b : c :: x : \frac{cx}{b} = D b$.

Consequently $Ab = c - \frac{cx}{b}$; But by the Property of the

Circle $D b \times A b = F b^2$. Hence $F b = \frac{\sqrt{c^2 b x - c^2 x^2}}{b^2}$; and

$F E = \sqrt{\frac{4c^2 b x - 4c^2 x^2}{b^2}}$; But the Area of the Parabola

$F C E b$ is $= \frac{2}{3} C H \times F E, = \frac{\sqrt{16c^2 b x - 16c^2 x^2}}{9 b^2}$.

Which is to be a Maximum: In Fluxions $48c^2 b x^2 x - 64c^2 x^3 x = 0$; Divide the Terms by $64c^2 x^2 x$ and we have by Transposition $x = \frac{3}{4} b$. That is in Order to make the greatest Parabola, the Cone must be cut at $\frac{3}{4}$ of its Side.

QUESTION

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QUESTION the 10th, answered by R. F.

Let the Curve sought be represented by $A p P$ (See Fig. 8.)

I say the Fluxion of the Area of every Curve is $= yx$;

Consequently by the Question we have $\frac{3x^2 \dot{x}}{a} = yx$;

and by Multiplication and dividing by $3x$, $x^2 = \frac{ay}{3}$.

Therefore the Curve sought is the Exterior Part of the *Appollonian* Parabola, the Parameter being $= \frac{1}{3}a$; For let $AQ = PM = x$; $PQ = AM = y$; then by the Nature of the Parabola $\frac{1}{3}ay = xx$. Now it's plain, that the Area of the Parabola $A p P M$ is $= \frac{1}{2}xy$; Ergo the Area $A p P Q A$ is $\frac{1}{2}xy$; Now (because of $\frac{1}{3}ay = x^2$) $y = \frac{3x^2}{a}$; put this Value of y in the above Equ-

tion, and $\frac{1}{2}x \times \frac{3x^2}{a} = \text{Area } A p P Q A = \frac{x^3}{a}$ which was to be demonstrated.

QUESTION the 11th, answered by J. B.

ALL heavy Bodies projected obliquely describe Parabolas (excepting that very small Difference, which the Resistance of the Air may be supposed to make.) Now draw the Lines, (as in Figure the 9th.) and AB being

given $= 2400$. Yards, and the Angle $BAR = 32:00$; BR will be found $= 1499.96$; Put $b = 1499.96$; $c = 2400$.

$AT = x$; Then $AR^2 = SB^2 = c^2 + b^2$; Again AB

$(\phi) : BR (\phi) :: AT (x) : TQ = \frac{bx}{c}$ by similar Triangles;

And $SB^2 : AQ^2 :: BR : QM$. per Conics. That is

$c^2 + b^2 : \frac{c^2x^2 + b^2x^2}{c^2} :: b : \frac{bx^2}{c^2} = QM$. Wherefore TM

$= \frac{bx}{c} - \frac{bx^2}{c^2}$, $= \frac{bcx - bx^2}{c^2}$ Let this flow till it become

sm or a Maximum, and then $bcx - 2bx^2 = 0$. Hence $x = \frac{1}{2}c$, and it's evident that if the Amplitude AB be bisected

ANSWERS to the last Arithmetical Questions. 23

bisected in r , and from the Point t the Perpendicular tm be erected, then tm will be the greatest Altitude to which the heavy Body will ascend, when projected according to the Direction AR ; lastly to determine the Quantity of tm , in the Equation above, viz. $\frac{bc^2 - bx^2}{4c}$, for x put its

Value before found $x = \frac{1}{2}c$, and TM or tm is $= \left(\frac{bc^2}{2c^2} - \frac{bc^2}{4c^2} \right) = \frac{b}{4}$. Equal to $\frac{1}{4} BR$ Or 374.99 Yards.

QUESTION the 12th, answered by J. T.

SUPPOSE DCM (as in Fig. 10.) to be the Curve whose Property we seek, draw the Lines as in the said Scheme, and put $AB = BC = a$, (because the Angle BAC is 45 Degrees) $BP = x$; $PM = y$; Then is $AP = a + x$; and the Similar Triangles ABC , APB will give $a : x :: a + x : a + x = PE = BM$ by the Tenour of the Question. Now in the right-angled Triangle BPM : $BM^2 = BP^2 + PM^2$. Analytically expressed is $a^2 + 2ax + x^2 = x^2 + y^2$. Or $y^2 = 2ax + aa$; Which is an Equation belonging to a Parabola, which because it contains three Terms, shows that the Vertex of the Parabola is not in the Point B .

But in order to find its Vertex, divide the Equation by 2, and then $\frac{1}{2}y^2 = ax + \frac{1}{2}a^2$. Put $b = x + \frac{1}{2}a$, and the Equation will become $\frac{1}{2}y^2 = ab$; Or $y^2 = 2ab$. Hence its plain that $2a$ is the Parameter of the Parabola, and $x + \frac{1}{2}a$ the Abscissa. But if we bisect BA in D , then PD is $= x + \frac{1}{2}a$; and D is the Vertex: And because $2a$ is the Parameter, B will be the Focus; for $BD = \frac{1}{2}a = \frac{1}{4}$ the Parameter, which is a noted Property of the Parabola.

QUESTION the 13th, answered by R. F.

FIRST of all here is given the Area of the Equilateral Triangle BfP (Vid. Fig. 11) = 500.564 square Yards $= b$; Put $x =$ Side of the Triangle, Then is $SP = \frac{x}{2}$;

and $\sqrt{x^2 - \frac{x^2}{4}} =$ the Perpendicular Sf ; consequently

24. ANSWERS to the last Arithmetical Questions.

$$\frac{x}{2} \times \sqrt{x^2 - \frac{x^2}{4}} = b ; \text{ Or } \sqrt{\frac{3x^4}{16}} = b : \text{ and by Invo-}$$

$$\text{lution, Transposition and Division } x = \sqrt[4]{\frac{16b^2}{3}} = 34$$

Yards. And hence Sf comes out $= 29.445$ Yards, put this $= d$; and $PS = 17 = c$; y = the Parameter: then by

the Nature of the Curve $Vf = \frac{y}{4}$; and besides we

$$\text{have } \frac{y}{4} + d \times y = c^2 \text{ Or } y^2 + 4dy = 4c^2. \text{ And by}$$

Extraction $y = \sqrt{4c^2 + 4d^2} - 2d = 9.11$ Yards the Parameter, and the Abscissa $VS = 31.7225$. And the Area of the Parabola is 719.044 Square Yards.

QUESTION the 14th, answered by I. T.

Let the Orbit pq (Fig. 12.) be supposed a Circle, and let another Body be imagined to revolve in this Orbit at the Earth's Superficies: And if the Semidiameter Sp be Unity, the *Latus Rectum* of the Orbit pq (being a Circle) will be $= 2$. And the Square of the Perpendicular let fall upon the Tangent $pr = 1$. SP will likewise be $= 10$, and the Square of the Perpendicular let fall upon the Tangent $PR = 75$; (by Reason of SP gi-

ven $= 10$, and the Angle $SPR = 60 : 00$;) the Angle SPK is also known to be 60 Degrees; for in an Ellipsis the Tangent makes equal Angles with the two Lines SP , HP drawn from the two Foci to the Point of Contact, viz. $\angle SPR = \angle HPY$ as is demonstrated by the Writers on Conicks: But all the Angles that can be formed upon a right Line are $= 180$ Degrees; consequently $SPK = 60$ Degrees likewise. Hence PK will be $= 5$. and $2SP + 2PK = 30$; Moreover that the *Latus Rectum* of the Orbit PQ may be found, it is to be noted that the Velocity in p is to the Velocity in P as 4.92 to 1.50. For Sir ISAAC NEWTON has demonstrated in *Prop. 15. Sect. 3. Lib. 1.* of his *Phil. Nat. Principia Mathematica*, That if any Number of Satellires move round the Earth, the Squares of the Periodic Times are as the Cubes

Cubes of the Semi-transverse Axes. Let us take the Moon, whole mean Distance from the Centre of the Earth

is 60 Semi-Diameters, and its Period = 27:7:43 Or 39343 Minutes, and compare it with one that revolves at the Earth's Superficies.

By the above Rules : As,

60X60X60 : 1X1X1 :: 39343X39343 :: 7166.07 whose Square Root is 84.68 equal to the Number of Minutes the Body would perform its Period in, in the Orbit

$pq = 1:24:40 = 5040$. But the Periphery of its Orbit is equal to the Circumference of the Earth = 24928 Miles, Ergo its Velocity is such, as makes it go 4.92 Sec. Miles each Second : But the Body in P goes only 1.5 Miles in the same time, consequently the Velocity in p , is to the Velocity in P as 4.92 Sec. to 1.5. Therefore the duplicate Ratio of the Velocity in p to the Velocity in P will be the Ratio of 242064 to 22500. And this Ratio compounded with the duplicate Ratio of the Perpendiculars let fall upon PR and pr , viz. with the Ratio of 1 to 75 makes the Ratio of the Number 242064. to 1687500. I say then as 242064 : 1687500 :: 2 (equal to the *Latus Rectum* of the Orbit pq) : 13.943 ; the *Latus Rectum* of the Orbit PQ. Therefore L = 13.943 and consequently the Figure described is an Ellipsis, and $2SP + 2PK - L = 16.057$ Then to find PH: I say, As $(2SP + 2PK - L)$ 16.057 : (L) 13.943 :: (SP) 10 : PH = 8.683 Hence $SP + PH$ namely the Greater Axis of the described Ellipsis is = 18.683 ; All this is abundantly manifest from Cor. 1. Prop. 16. and from Prop. 17. of Lib. 1. of Newton's *Principia*.

The Conjugate Axis of the Section Mw is $= \sqrt{SP + PH \times L} = 16.140$; And from the Square of the Semi-Transverse, subtracting the Square of the Semi-Conjugate Axis, there remains CH or the Eccentricity of the Figure = 4.705 ; Hence the greatest Distance of the Body when in the *Apogæum* will be = 14.046 ; And the least in the *Perigæum* = 4.637 ; And thus much for the Form.

D

As

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As to what respects the Position, since SH is known, and $KH = PH - PK = 3.863$ and the Angle SKH right, or 90 Degrees : the Angle KSH will be found

$= 23 : 3$ But the Angle KSP is $= 30$ Degrees, since SPK is $= 60$ Degrees : Hence the whole Angle PSH

will be $53 : 3$ therefore the Position of the Transverse Axis, and consequently of the whole Figure, is known.

Lastly, that the Periodic Time may be known, it's to be considered, that the Periodic Time in the Orbit *pq*

above found is $1 : 24 : 26$ or 5066, which Number squared produces 25664756 ; I say then, As the Cube of the Semi-Transverse Axis of the Orbit *pq* (1) is to the Cube of the Semi-Transverse Axis of the Orbit PQ in round Numbers (875.) So is the Square of the Periodic Time in the Orbit *pq* (25664756) To the Square of the Periodic Time in the Orbit PQ $= 20916450140$. The Square

Root of which gives 144631. for the Periodic Time in the Orbit PQ, which reduced is $= 1 : 16 : 10 : 31$.

Q. E. F.



New

New ENIGMAS to be answered.

(1.) ENIGMA the 17th, by — —

I Live beneath the tow'ring Height
 Of *Ætna's* flaming Head,
 I range the Circle of the Globe,
 Earth's Centre is my Bed :
 I give the sweetness to the Grape,
 I paint the Violet blue,
 I cause the Diamond to shine,
 And I distill the Dew :
 I thaw the frozen Alps, and throw
 The flowing Rivers down,
 I make the mighty Mountains quake,
 And hurl them on the Town :
 The Thund'ring Cannons I discharge,
 I burst the Sable Cloud,
 I make the dreadful Lightnings flash,
 And Thunder roar aloud :
 I make the Springs ascend the Hills,
 I cloath the Vales below,
 I give to ev'ry Beast its Food,
 I make the Rivers flow.
 Towns, Fields and Forests I destroy
 By my avenging Power,
 For when my Fury I exert,
 It proves a fatal Hour.
 I tear up Mountains by the Roots,
 I raise the Vallies high,
 I penetrate beneath the Sea,
 I drink the Rivers dry :
 In the last Scene I'll act my Part,
 With Nature I begun,
 I'll bear an universal Sway
 E'er yet my Race be run.

(2.) ENIGMA the 18th, by I. H. M.

EST mihi parva Domus solidis circumdata Muris,
 Tale sed Ars Castrum condere docta nequit ;
 Turus in hac latitans, placidis indulgeo Somnis,
 Nec minuant Vires Tempora longa meas ;

*Solares Aestus, concretaque Frigora sperno,
 Imbre licet Niveo seva Procella ruat.
 Hic torpens requiesco, Oculis non Visus acutis,
 Ferrea dum subitam dant mihi Tela fugam
 Protinus, in Lucem productus, pabula posco,
 Quis si non potiar, langueo Morte citâ.
 Donèc adhuc Mundus primævo flore juventæ
 Gaudebat, Genti cuique benignus eram,
 Vera tamen fateor, quod posterioribus annis,
 Belli sanguineis Artibus arma dedi,
 Si mihi quid nomen, quæ sit quoque mansio certa,
 Tu bene conjicias, OEdipus alter eris.*

(3.) *The above ENIGMA translated.*

Within a close compacted Citadel,
 Surpassing all that Art can boast, I dwell :
 And whilst of such a strong Defence possess,
 Secure from all surrounding Dangers rest.
 The keen Assaults of Heat and Frost defy,
 Nor fear the Rage of a tempestuous Sky :
 Here, I in Silence sleep my Time away,
 Nor will my Native Properties decay,
 Though I should reach the Years of old *Methuselah*.
 In this unactive State I must remain,
 Till force of Arms my Liberty obtain ;
 Then I like One by sudden Fright awake,
 With nimble Speed my drawsv Bed forsake.
 The very Moment I am brought to Light,
 I have a most impatient Appetite :
 And if the Food, my Nature does require
 Should be deny'd, I instantly expire ;
 By Providence I seem'd at first design'd,
 A publick Benefit to Human kind ;
 But of late Years, have had a guilty Share
 In the destructive Miseries of War.
 Pray tell my Name, and Place of my Abode,
 And I your Wit, (fair Ladies) will applaud.

(4.) *ENIGMA the 20th, by OEdipus Eboracensis.*

Where Politeness prevail'd, I seldom e'er fail'd
 A just Veneration to claim ;
 Yet, who was my Father, 'tis doubtful to gather
 From all the best Records of Fame.

Upon

Upon a Review, 'tis probably true,
That to the old World I was known ;
But in Proceſs of Time, Men of Genius ſublime,
Entail'd on my Merit a Crown.
Scarce a beautiful Part, of Nature or Art,
But of my ſweet Bounty hath taſted ;
And (to my Diſgrace) on Things vile and baſe,
My Treasure has often been waſted.
Dreſs'd in modiſh Faſhion, a great Reputation
With Perſons of Honour I gain ;
And of this can glory, that both Whig and Tory,
My Intereſt help to maintain :
But although I find Entertainment ſo kind
Amongſt both the Learned and Great,
I (free from all Pride) condeſcend to reſide
With ſome of interior State.
By Night or by Day, when my Temper is gay,
To Pleaſure and Mirth I excite ;
But ſpiteful do prove, if mine Anger you move,
And often moſt cruelly bite.
A virtuous Saint, I ſo lovely can paint,
That I ſeem of Extraction divine ;
But at certain Times, the lewdeſt of Crimes,
To propagate baſely incline :
To Myſtries prophetick, in Language pathetick,
I formerly made a Pretence ;
But in theſe wiſer Days, ſuch Kind of Eſſays,
Are ridicul'd by Men of Senſe.

(5.) *ÆNIGMA the 21ſt, by J. H. M.*

NO Wonder that, in Countries, where the Prince
With uncontrouled Power his Scepter ſways,
Th' unhappy Subjects (ſtripp'd of all Defence)
In painful Hardſhips linger out their Days.
But I, a Native of the *Britiſh* Iſle,
Where Liberty and Property abound,
Though guilty of no Injury or Guile,
Have yet the moſt inhuman Uſage found.
My Publick Service, and Majeſtick Form,
For Favour and Compaſſion loudly call ;
Yet, like an uſeleſs deſpicable Worm,
To barb'rous Mirth a Sacrifice I fall :

The

The furious Mob, whom Ignorance excites,
 With Clubs and Staves my harmless Life pursue ;
 And, Strangers to true Rational Delights,
 With unrelenting Breasts my Torments view.
 Nor only those, but some there are who boast
 Of Birth and Education more refin'd ;
 Yet have all tender Sense of Pity lost,
 And to encrease my Suff'rings are inclin'd.
 The *Roman* Gladiators hardly knew
 Such cruel Mis'ries as we undergo ;
 For, arm'd with Spears, we deadly Wounds renew,
 And treat our nearest Kindred like our Foo.
 To make our Scene of Woe the more compleat,
 Whilst we lie struggling in the Pangs of Death,
 The rude Spectators ridicule our Fate,
 And with Huzza's attend our dying Breath.

(6.) ENIGMA the 22d, by W. W.

When first this Earthly Ball was made,
 And by th' ALMIGHTY firmly laid ;
 When Starry Orbs bespread the Sky,
 Existence I had none : For why
 When *Sol* began to rule the Day,
 And *Luna* trac'd her oblique Way,
 In diff'rent Parts I dormant lay ;
 'Till some ingenious Artift, who
 Deserves our Praise, and Wonder too,
 Discover'd, form'd, and brought me forth,
 I'm now become an Help on Earth.
 Of various Parts I am compos'd,
 Hid Secrets are by me disclos'd ;
 By *Art* I do raise up the Dead ;
 And make him lift his drowsy Head :
 I'm mighty useful unto all,
 Both High and Low, and Great and Small ?
 Yet through my Race I'm subject to
 Diseases which I undergo,
 Which bring me oft to bad Condition,
 If not reliev'd by my Physician ;
 Who soon applies a Lenitive,
 True Service then again I give.
 In sev'ral Countries make my Stay,
 As *England*, *France*, et cetera ;

But

But in what Land soe'er I be,
I must have a Xenodochy :
When placed there I seem at Rest,
Nor Heat nor Cold do me molest.
My Business is to tell true Tales,
Yet oftentimes my Skill me fails :
But this to me is no Disaster,
'Tis all imputed to my Master.
But hold. Let me declare no more,
I've said enough. My Name explore.



New

New Mathematical QUESTIONS to be answer'd

(1.) QUESTION the 43d, by R. P.

THREE Merchants when returning home,
 Each from a different Fair,
 By Accident to the same Inn
 For Lodgings did repair :
 Supper being ended, they began
 To reckon up their Gains,
 Hoping they would sufficient be
 To recompence their Pains ;
 When right cast up, the total Sum
 Two Thousand Crowns was found,
 This rais'd their Spirits, and made the Glass
 Circulate briskly round.
 Moreover if you add the Gain
 Of the First and the Second,
 And of the Third's Gain, the Cube Root
 Subtract from thence, I reckon
 There then will rest, if you have done
 The Work precisely true,
 The Gain of the first Merchant ; more
 Three Hundred Sixty Two. [viz. 362 Crowns.]
 But add the Profits of the Second,
 And of the Third exact,
 And the Square Root of the first's Gain,
 From the said Sum subtract,
 You'll find remaining, when the Work
 Shall be compleatly done,
 The Gain of the third Merchant ; more
 Three Hundred Forty One. [viz. 341 Crowns.]
 I wish that some ingenious Pen,
 Would unto me explain,
 From these *præ-cognita*, th' Amount
 Of every Merchant's Gain.

(2.) QUESTION the 44th, by G. Tr.—t.

FOUR Men, (*viz.*) A, B, C, D, have each a certain Number of Crowns unknown, the Crowns of
A, B, C,

A, B, C, multiply'd together, make 252; those of B, C, D, multiply'd together, make 756; those of C, D, A, multiply'd together, make 336; and those of D, A, B, multiply'd together make, 432; Quere how many Crowns each Person had.

(3.) QUESTION the 45th, by the same.

AN unknown Sum of Money is to be divided amongst an unknown Number of Men, if there had been two Men more, they would have had Ten Pounds a-piece less: But if there had been two fewer, they would have had Twenty Pounds a-piece more; what was the Sum of Money, and the Number of Men?

(4.) QUESTION the 46th, by S. D.

UPON a Friend's Request the other Day, A Field * triangular I did Survey;
The difference of the Legs I found to be
Exact One Hundred, Forty Yards and Three,
Likewise, if from the Angle right you shall
A perpendicular to th' † Base let fall.
The greater Segment will be to the less
Ith' || Ratio which the Margin does Express.
This being known, tell me I pray,
Each Segment, Side, and Area.

(5.) QUESTION the 47th, by J. N.

IN the Triangle A, B, C, (Fig. 15.) there is given the Side A C = 88; Chains, and the Side B C = 95. and the Side A B = 58. Now suppose the Side C A be produced to D, so that A D = 10. Chains, and the Perpendicular D E being erected equal to 50. Chains, its required to draw from E, the Line E S P. in such Sort, that the Triangle A B C may be to the Triangle A S P in the Ratio of 5 to 3.

(6.) QUESTION the 48th, by J. T.

TWO Tyro's in the Mathematicks, late
Together had a very warm Debate,

* Right-angled.

† Or Hypothenuse.

|| As 3 to 2.

E

Yet

34 *New Mathematical Questions, to be answered.*

Yet after long Engagement in Dispute,
Neither could his Antagonist confute :
A Triangle right-angled was the Question,
Which prov'd too hard for their weak Minds digestion.
In which (as I'm inform'd) the Data were
Th' Hypothenufe, and Side o'th' inscrib'd Square.
Says one, with positive asseveration,
It may be solv'd by a Quadsatic Equation :
Quoth th' other your Assertion I deny,
And (if you please) shall give the Reasons why.
Now, if some Friend, experienc'd in this Art,
In the next *Miscellanea* will impart,
To the said Question a Solution true ;
Repeated Thanks will for his Pains be due.

(7.) *QUESTION the 49th, by J. T.*

A Triangle A B C (*vide* Fig. 14, the Sides A C,
B C, of which are produced towards H and G)
being given : If from any Point P taken in the Base
A B, we erect the Perpendicular P E F, and if we
take P M equal to a mean Proportional between P E and
P F ; and find an infinite Number of such Points M ;
it is required to find a Curve which is the Locus of
them all.

(8.) *QUESTION the 50th, by J. T.*

ONE * Evening as I walk'd alone, * In April
'Twas in a Meadow green, d.
I th' Latitude of † Fifty Three, † 53 : 0 N.
The Sun that Time was seen :
His Azimuth was from the South,
Degrees just Forty Three,
If to this Altitude, his Declination added be,
Just Fifty Nine Degrees their Sum ;
|| Tell me from hence I pray,
The Day o'th' Month when this was done,
Likewise the Hour o'th' Day.

(9.) *QUESTION the 51st, by J. T.*

T Here is given the Height of a Parabolic Conoid equal
to 30 Inches, and the Diameter of its Base 48

|| Required to project this Stereographically, and to solve it both
Trigonometrically, and Algebraically.

Inches

New Mathematical Questions to be answered. 35

Inches ; required to find the Content of the greatest Conic-Frustum that can be inscrib'd therein, in Wine Gallons.

(19.) QUESTION the 52d, by R. F.

UPON the right Line HI (*vide* Fig. 15.) let the Semi-Circle HGI be described, and let there be any other right Line AB , bisected in C , and from C erect a Perpendicular $CD = GF$; and the Perpendicular LN being erected upon any Point of the Diameter HI , let it be made as $DC : AC :: HL : AP$, and in P let the Perpendicular PM be erected $= NL$: It's required to find the Locus of all the Points M , found after this Manner.

(11.) QUESTION the 53d, by J. T.

ADMIT two Ports thus situated be, d
One in the Latitude of * Thirty Three : * $33 : 0 N.$

Th' other in † Fifty Four North Latitude, † $54 : 0 N.$
Forty Degrees their difference of Longitude. d

Also in || Eighteen South an Island lies, || $18 : 0 S.$
Which from th' abovesaid Port, (I must premise)
Is Equi-distant. Now I beg that you;
How far the Island is from each, would shew,

(12.) QUESTION the 54th, by J. T.

LET there be a Rhomboides, the two longer parallel Sides of which, are each equal to 82. Feet, and the two shorter each equal to 55. Feet, and the acute Angle thereof 68 Degrees; its required to inscribe an Ellipsis therein which shall touch the four Sides : Or what amounts to the same Thing, given the two conjugate Diameters of an Ellipsis = 82. and 55. Feet, and the Angle they contain 68 Degrees; to find the Position and Magnitude of the Transverse and Conjugate Axes, and to construct the same Geomettrically.

Having among some old Papers accidentally met with a small Pamphlet, called, *The Mathematical Delights*, printed at *Newcastle*, and as I cannot find by what Enquiry I have made, that there ever was any more than one published, and consequently no Answers to the Questions therein contained: I have taken the Liberty to borrow the two following Ones from thence, and to

36 *New Mathematical Questions to be answered.*

present 'em to my Reader in the very same Dress I found them.

(13.) QUESTION the 55th, by E. H.

A Gentleman had a Meadow, in Form an Oblique angled Triangle, the Fences of which being drove away by a Flood, and consequently thrown in common with the Neighbouring Ground; and having lost the Dimensions, only remember'd this, (*viz.*) that there stood an Oak in the Neighbouring Ground, from which if a right Line were produced to each Side of the Meadow, in its nearest Distance, would divide each Side into two equal Parts; the Lines being in Measure 81.25; 118.75; and 468.75 Chains; required the Sides and Area of the said Meadow.

(14.) QUESTION the 56th, by R. C.

TWO Ships the *William* and *Mary*, sail from an Island in North Latitude, and are bound to an Island in South Latitude; the Ship *Mary*, sails between the South and the West; and the Ship *William*, sails between the South and the East; they having made an

Angle of $50:37$ between them, and then they find themselves upon the Equinoctial Line just 46 Leagues asunder; the *Mary* still keeping the same Course as at first, she falls in with the Island. The *William* alters his Course from the Equinoctial, and runs 20 Leagues between the South and the West, then he finds the Island sail'd from to bear off him due North, he still keeping the same Course, falls in with the Island where the *Mary* is: The Meridian Distance of this Island is found to be 70 Leagues Westward: from hence I demand both their Courses steer'd, and their Distance run, and the Latitude of the Island sail'd from, as also the Latitude they are now in.

Of

Of the INVENTION of the METHOD of FLUXIONS.

THERE has not perhaps any Thing in the Mathematical World made so great a Noise as the late Controversy between Sir *Isaac Newton* and Mr. *Leibnitz*, concerning the Invention of the Method of Fluxions, (called by Foreigners, the Differential Calculus) the whole State of the Case was published in the Year 1715, in a Book call'd, *Commercium Epistolicum Gollingii et aliorum de Analyt. promota*, only a very few Copies of it were printed and sent to the Fellows of the Royal Society, and to such Mathematicians as could judge of those Matters, nor are to be bought; but, since that Time, it was translated out of English into Latin, and published in the Year 1722; from which Edition I shall select such Passages as may give the Reader a clear View of the Dispute, and enable him to judge thereupon.

In the Year 1669, Dr. *Barrow*, having received from Sir *Isaac* (then Mr.) *Newton*, a small Treatise, call'd, *A General Method of the Quadrature of Curves by infinite Series*, communicated the same to Mr. *J. Collins*, wherein is laid down a Demonstration of the Rule for the Quadrature of Curves, which is the common Foundation both of the Doctrine of Fluxions, and of the differential Calculus, by which its evident he had invented the Method before that Time. In the beginning of the Year 1673, Mr. *Leibnitz* was in *England*, and again in *October* 1676, and the Interval of this Time, he spent in *France*, during which he kept a Correspondence with Mr. *Oldenburgh*, and by his Means, with Mr. *Collins*; and sometimes, also with Mr. *Newton*, from the last of whom, he received a Letter dated 13th of *June*, 1676, wherein is taught the Method of reducing Quantities into infinite Series, that is, of exhibiting the Increments of flowing Quantities: This Method was utterly unknown to Mr. *Leibnitz*, before he received the abovesaid Letter of Mr. *Newton*'s, as he himself acknowledges in his Letter to Mr. *Oldenburgh*, dated *August* 27, 1676, for before that

38 *Of the Invention of the Method of Fluxions.*

that Time, he was obliged to transform an irrational Quantity into a rational Fraction, and then by Division, after the Method of *Mercator*, to reduce the Fraction into a Series. Furthermore its evident, that Mr. *Leibnitz* did not then understand these Series, because in the same Letter, he desires that Mr. *Newton* would explain to him the Manner how he got those Series: Again, in a second Letter from Mr. *Newton* to Mr. *Leibnitz*, dated *October 24. 1676*, he gives yet clearer hints of his Method, and illustrates it by Examples, and lays down a Rule by which, from the Ordinates of certain Curves being given, their Areas may be obtain'd in finite Terms, when it is possible. By these Lights, and assisted by these Examples, an ordinary Genius might have understood the *Newtonian* Method, much less can we expect that it should yet lye conceal'd from the acute Mr. *Leibnitz*: After this, viz. in the Year 1677 Mr. *Oldenburgh* dying, an End was put to this Correspondence, and Mr. *Leibnitz* returning to *Hanover*, he first published in the *Acta Eruditorum Lipsiensia*, for 1684 the Elements of the differential Calculus, nor do there appear the least Footsteps, (nor does he himself pretend) that he had the Method before the Year 1677, that is, after he had received the two above-mentioned Letters from Mr. *Newton*. But upon the Publishing of Sir *Isaac Newton's* Books of the Number of Curves of the first Kind, and of the Quadrature of Figures, the Editors of the *Leipsick Acts* began to insinuate, that Mr. *Leibnitz* was the first Inventor of the differential Calculus, and that Sir *Isaac Newton* had substituted Fluxions for Differences, which are nearly as the Increments of Flowing Quantities generated in very small Particles of Time; and had used them very elegantly, as well in his Mathematical Principles of Natural Philosophy, as in other Treatises, afterwards published by him. Just as *Honoratus Faber* in his *Synopsis Geometrica*, had substituted a Progression of Motion for *Cavallerius's* Method of Indivisibles.

The Meaning of which Words, is this, that Mr. *Newton* had substituted Fluxions for the *Leibnitian* Differences, as *Honoratus Faber* had substituted a Progression of Motion, for, The Method of *Cavallerius*: That is, that Mr. *Leibnitz*

Leibnitz was the first Inventor of this Method, and that Mr. *Newton* had received the same from him, and had substituted Fluxions for Differences.

Excited by these Insinuations, Mr. J. KEIL, in a Letter printed in the *Philosophical Transactions* for the Months of *September* and *October*, 1708, wrote on the contrary, That, without all Dispute, Mr. NEWTON was the first Inventor of the Algorithm of Fluxions, as was evident to any one, that had read his Letters, published by Dr. *Wallis*; and that the same was afterwards published by Mr. LEIBNITZ in the *Acta Eruditorum*, he having first changed the Name, and Manner of Notation. Mr. LEIBNITZ, being offended thereat, complained to the Royal Society against Mr. KEIL; and insisted, that he should publicly confess his Fault. Dr. KEIL chose rather to answer in Writing to those Things of which LEIBNITZ had complained, in which Letters he more fully explained and vindicated what he had before asserted: But Mr. LEIBNITZ, not at all satisfy'd herewith, wrote again to the Royal Society, in which he still complain'd of Dr. KEIL, calling him an Upstart, and one that had little Knowledge of Matters transacted so long before, nor having a Commission from him who was chiefly interested in the Dispute, (that is, from Sir ISAAC NEWTON) and referr'd it to the Judgment of the Society, whether such vain Babblings, and unjust Calumniations, ought not to be restrained. Mr. LEIBNITZ was in *England* in the Beginning of the Year 1673, and again in the Month of *October* 1676; and in that Interval spent his Time in *France*, during which Space he had a Correspondence with Mr. OLDENBURGH, and by his Mediation with Mr. COLLINS and Mr. NEWTON: Now upon what he learnt in *England*, or from that Intercourse of Letters before-mention'd, all the Question turns. Mr. OLDENBURGH and Mr. COLLINS are long ago dead: As for Mr. NEWTON, he then resided at *Cambridge*, and knew little more of the Matter than what appear'd from his own Letters afterwards published by Dr. WALLIS. Mr. NEWTON can not be a Witness on the Part of Mr. KEIL; nor Mr. LEIBNITZ on his own: But other Witnesses there is none remaining alive. Wherefore the Royal Society being twice appealed to by Mr. LEIBNITZ
against

against Dr. KERR, appointed a select Committee out of the Society, who should examine the Original Letters, and the Books of the Copies of Letters, and other Papers left by Mr. OLDENBURGH in the Custody of the Society, or whatever else could be found among the Papers of Mr. J. COLLINS relating thereto, and should give in their Opinion to the whole Body: The same Committee brought back a Collection out of the Letters, and other Manuscripts, afterwards printed under the Title of, *Commercium Epistolicum GOTTFRIDI et aliorum de Analytici promota*, together with their Opinion, which was as follows.

[The Remainder in our next.]

F I N I S.



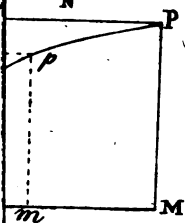
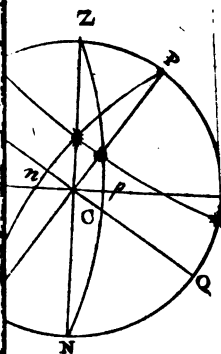


Fig 13

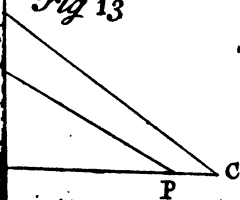
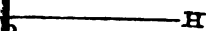


Fig 10



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Miscellanea Curiosa :
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Entertainments
FOR THE
Ingenious of Both Sexes.

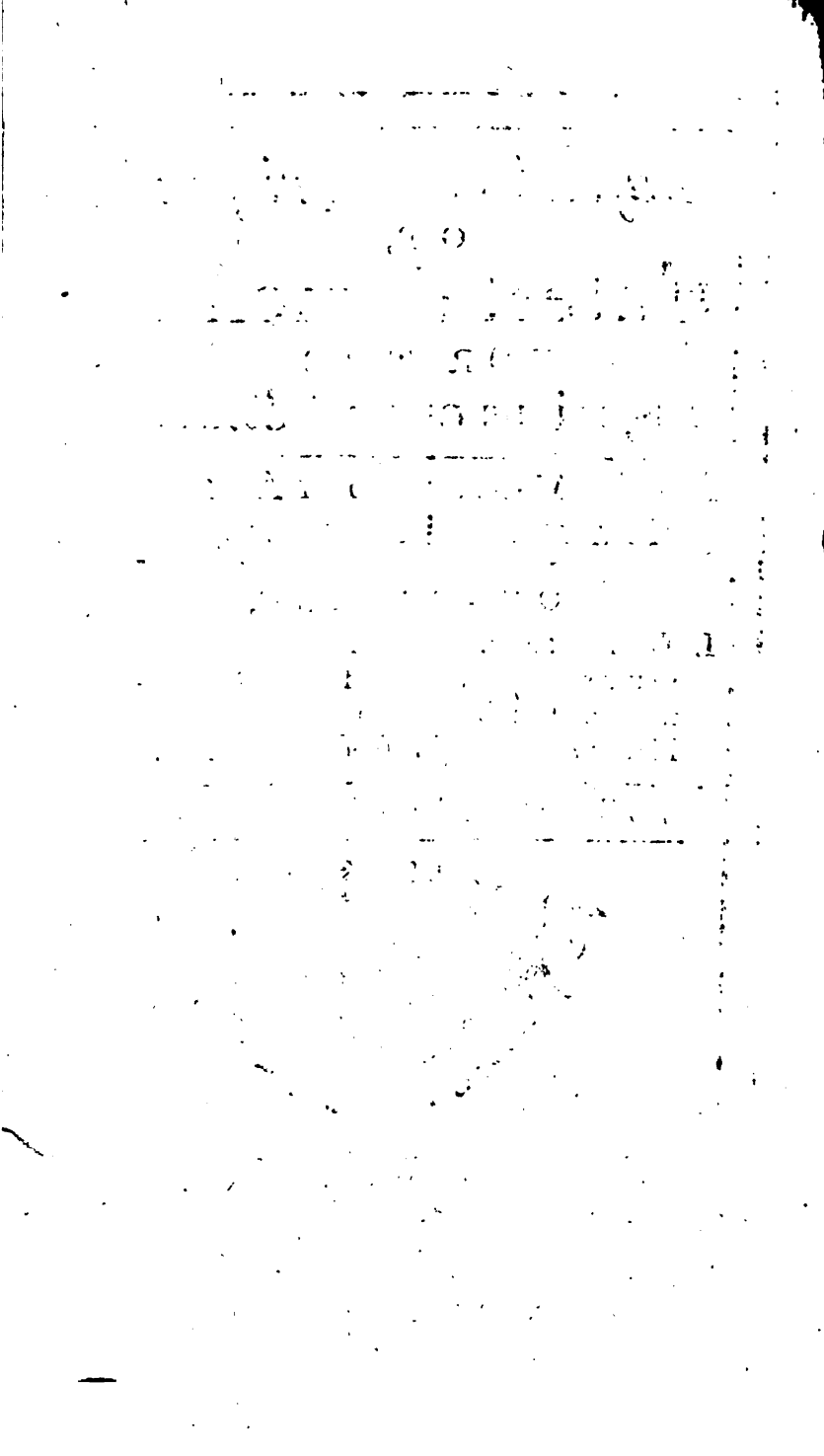
For the MONTHS of APRIL,
MAY and JUNE, 1735.

CONTAINING,
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QUESTIONS. Suited both to Begin-
ners, and also to such as have made
higher Advances in these STUDIES.

Scribimus Indocti Doctique. —————



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T H E P R E F A C E.



IN Order to the making any considerable Proficiency in the Mathematick Sciences, there seem to be requisite these Four Things. 1st, *A Good Natural Genius, as the Basis and Foundation.* 2dly, *A Sufficiency of vacant Time, - too frequent Avocations breaking the Intention of the Mind from the Subject contemplated ; and (as it generally happens in the Mathematicks) if the Matter under Consideration have a great many preparatory Steps, it interrupts the whole Design.* 3dly, *Industry and Application, without which no good Fruit is to be expected in any Sort of Literature.* 4thly, *External Helps and Assistances, either immediately from Persons themselves, or by their Writings : And indeed this is not only lawful, but absolutely necessary, since the Object of our Consideration is no less than the Universe itself : And whoever considers duly the vast Industry, Sagacity, Multitude of Observations and Experiments, and other intrinsick Things necessary to compleat a System of the Mathematicks will readily believe that it is not the Work of one Man, or of one Age. And we cannot sufficiently wonder at the Industry of the Mathematicians, and the Power of Numbers and Geometry well apply'd, when we reflect upon the vast Progress they have made in this Art. Now as the Writings of Others are the best and general Way of improving herein, I shall briefly enumerate some of the most eminent Authors, who have*
treated

4 The P R E F A C E.

*treated upon the several Branches of the Mathematicks :
And first,*

Writers on Vulgar Arithmetick, and Specious, or Algebra.

Dr. WALLIS's }
Mr. KERSEY's } ALGEBRA.

WARD's Young Mathematician's Guide.

RONAYNE's Algebra.

STURMIUS's Mathesis Enucleata.

JONE's Synopsis Palmariorum Matheseos.

Sir ISAAC NEWTON's Arithmetica Universalis.

On GEOMETRY.

Euclid's Elements, by }
TACQUET.
COMMANDINE.
Dr. BARROW.
Dr. GREGORY.

On CONICK-SECTIONS.

Dr. MILNES's

M. Del HOSPITAL's

Dr. HALLEY's Appollonius.

Mr. De la HIRE's

} Conics.

On TRIGONOMETRY.

Mr. GASWELL's

Dr. KEIL's

Mr. NEWTON's

} Trigonometry.

On DIALLING.

Mr. W. LEYBOURN's Dialling.

On ASTRONOMY.

Dr. GREGORY's

Dr. KEIL's

} Astronomical Lectures.

On OPTICKS and PERSPECTIVE.

Mr. MOLINEUX's Dioptricks.

Dr. B. TAYLOR's Linear Perspective.

ASTRONOMICAL

The P R E F A C E.

ASTRONOMICAL TABLES for the Calculation of
ECLIPSES, and the PLANET'S Places.

STREET's *Astronomia Carolina*.

LEADBETTER's Tables.

CASSINI's Tables.

De la HIRE's Tables.

On FLUXIONS.

DITTON's Institution of Fluxions.

STONE's Translation of De L'Hospital.

HAYE's Introduction to Fluxions.

B. TAYLOR's Methodus Incrementorum.

On MECHANICS.

MATHEMATICAL PHILOSOPHY.

KIEL's Physical Lectures.

DITTON's Laws of Nature and Motion.

Sir ISAAC NEWTON's *Principia*.

JACOBI HERMANNI *Phoronomia*.

SYSTEMS OF BODIES of the MATHEMATICKS.

OZANAM's *Cursus Mathematicus*.

WOLFII *Corpus Mathematicum*.

LEYBOURN's *Cursus Mathematicus*.

Besides in the *Philosophical Transactions* may be found
several Things relating to the Laws of Chance, Infi-
nite Series, Hydrostaticks, Logarithms, &c.

But I must now hasten to other Matters, intending to
finish what relates to the Dispute concerning the Invention
of the Method of Fluxions in the present Book.

JUNE the 14th, 1735.





ADVERTISEMENT

To all LOVERS of
INGENUITY.

THE Editor intending to publish the next Quarterly Book in SEPTEMBER ensuing, desires that such Gentlemen and Ladies, &c. as think fit to encourage this Undertaking, either by promoting and recommending the Sale thereof, or by sending such Subjects either in Verse or Prose, as are suitable to this Design, would please to direct their Letters to Mr. THO. GENT, Printer, near the Star in Stone-Gate, YORK, Post paid, before the End of August next, where they will be carefully forwarded to the Author,

Whoever send either Enigmas, or Arithmetical Questions, are desired to give the Solution along with them, to prevent all Mistakes, or Ambiguity in the Terms: And I do assure the Buyers of this Treatise, that, in Process of Time, they shall have Questions in all the Branches of Mathematicks, viz. Arithmetical, Nautical, Geographical, Mechanical, Trigonometrical, Astronomical, Algebraical, and in Fluxions, together with exponential Equations, and the Construction of Algebraic Equations, and finding their Loci; to suit the Tastes of all Persons, and render the Work generally usefull.

Omne tulit punctum, qui miscuit utile dulci.



Miscellanea



Of the INVENTION of the METHOD of FLUXIONS.



The OPINION of the COMMITTEE appointed to examine the Original Letters and Copy-Books of Letters in the Custody of the ROYAL SOCIETY, relating to the Dispute between Sir ISAAC NEWTON and Mr. LEIBNITZ; concerning the Invention of the Method of Fluxions.

+++++ We have consulted the Letters and Letter-Books
W in the Custody of the ROYAL SOCIETY, and
+++++ those found among the Papers of Mr. John
Collins, dated between the Years 1669 and
1677 inclusive; and shewed them to such as knew and
avouched the Hands of Mr. Barrow, Mr. Collins, Mr. Ol-
denburgh, and Mr. Leibnitz; and compared those of Mr.
Gregory with one another, and with Copies of some of
them taken in the Hands of Mr. Collins; and have ex-
tracted from them what relates to the Matter refer'd to
us: All which Extracts herewith delivered to you, we
believe to be genuine and authentick; and by these Let-
ters and Papers we find,

1. THAT Mr. Leibnitz was in London in the Beginning of the Year 1673, and went thence, in or about March, to Paris, where he kept a Correspondence with Mr. Collins, by means of Mr. Oldenburgh, till about September 1676, and then returned by London and Amsterdam to Hanover; and

8 Of the Invention of the Method of Fluxions.

and that Mr. Collins was very free in communicating to able Mathematicians what he had received from Mr. Newton and Mr. Gregory.

2. THAT when Mr. Leibnitz was the first Time in London, he contended for another differential Method, properly so called; and notwithstanding that he was shewn by Dr. Pell, that it was Mouton's Method, persisted in maintaining it to be his own Invention, by Reason that he had found it by himself, without knowing what Mouton had done before, and had much improved it. And we find no Mention of his having any other differential Method than Mouton's, before his Letter of the 21st of June 1677, which was a Year after a Copy of Mr. Newton's Letter, of the 10th of December 1676, had been sent to Paris to be communicated to him; and above Four Years after Mr. Collins began to communicate that Letter to his Correspondents, in which Letter the Method of Fluxions was sufficiently describ'd to any intelligent Person.

3. That by Mr. Newton's Letter of the 13th of June 1676, it appears, that he had the Method of Fluxions above five Years before the writing of that Letter. And by his *Analysis per Equationes Numero terminorum infinitas*, communicated by Dr. Barrow to Mr. Collins in July 1669, we find that he had invented the Method before that Time.

4. That the Differential Method is, one and the same with the Method of Fluxions, excepting the Name and Mode of Notation, Mr. Leibnitz calling those Quantities *Differences*, which Mr. Newton calls *Moments* or *Fluxions*; and marking them with the Letter *d*, a Mark not used by Mr. Newton. And therefore we take the proper Question to be, not *who invented* this or that Method, but *who was the first Inventor* of the Method. And we believe that those, who have reputed Mr. Leibnitz the first Inventor, knew little or nothing of his Correspondence with Mr. Collins and Mr. Oldenburgh long before; nor of Mr. Newton's having that Method above fifteen Years before Mr. Leibnitz began to publish it, in the *Acta Eruditorum* of *Leipsick*.

Of the Invention of the Method of Fluxions. 9

“ For which Reasons we reckon Mr. *Newton* the first
“ Inventor ; and are of Opinion, that Mr. *Keill*, in asserting
“ the same, has been no ways injurious to Mr. *Leibnitz*.
“ And we submit to the Judgment of the Society, whether
“ the Extract and Papers now presented to you, together
“ with what is extant to the same purpose in Dr. *Wallis*’s
“ Third Volume, may not deserve to be made publick.”

WHEN the *Commercium Epistolicum* was first published, Mr. *Leibnitz* being then at *Vienna*, that he might let it pass without any Answer thereto, pretended for two Years that he had not seen it ; but that he had appeal’d to the Judgment of an eminent Mathematician, who was very skilful in these Matters, and not at all a Party-Man : And dispers’d abroad his Opinion, dated the 7th of *June* 1713, inclosed in a flying Paper dated the 29th of *July*, without the Name either of the Judge, or of the Printer, or of the City in which it was printed. And about the End of the Year 1715, in his Letters which he wrote to Mr. *L’ Abbe Conti*, then at *London*, he (instead of replying to the *Commercium Epistolicum* as he ought to have done) flies off to New Queries concerning Occult Qualities, Universal Gravity, Miracles, the Organs and *Sensorium* of the Deity, Space, Time, a *Vacuum*, Atoms, the Perfection of the World, and a *Supra-Mundane* Intelligence ; and proposed a Problem taken out of the *Acta Eruditorum* to be solv’d by the *English* Mathematicians : All which Things have nothing to do with the Matter in Dispute.

Besides, he accused the Committee appointed by the Royal Society, who had published the *Commercium* from Antient Papers, as if they had been prejudic’d against him ; and, in printing the old Letters, had omitted all those things which either made for him, or against Mr. *Newton*. And to prove this, he wrote in his first Letter to the *Abbe Conti*, that in his Second Journey into *England*, Mr. *Collins* shew’d him a Part of his *Commercium*, in which Mr. *Newton* acknowledg’d his Ignorance in many Things ; and said (amongst others) that he had found out nothing about the Dimensions of Curvilinear Figures, excepting that of the Cissoid : But that the Committee had suppress’d all this. Mr. *Newton*, in his Letter to the aforesaid *Abbe Conti*, dated the 26th of *February*, 1715.

B

answered,

answered, *That this was not omitted by them, but was extant in his Letter sent to Mr. Oldenburgh the 24th of October 1676, and printed in the Commercium Epistolicum, Page the 74th, Lines the 10th and 11th.* Afterwards Mr. Leibnitz, in his next Letter to M. L' Abbe Conti, dated the 9th of April, 1719, confess'd, that he was mistaken. But, says he, *I will give you another Example.* NEWTON, in one of his Letters to Mr. Collins, owns, *That he could not find the Magnitude of the Second Sections (or Second Segments) of Spheroids, and such like Bodies: But that the Committee had not published this Passage, or this Letter.* In the Observations that Mr. Newton made upon this Letter of Leibnitz, he answers, *That if the Committee had omitted this, they had done it very justly, since Cavillings of this Nature have no Relation to the Matter in Question: But that the Committee had indeed not omitted it.* For Mr. Collins, in his Letter to Mr. Gregory of the 24th of December 1670, as also in his to Mr. Bertet 1671, (both printed in the Commercium, Pages the 24th and 26th) writes, *That the Newtonian Method extended to the Second Segments of Solids, which are generated by Rotation.* And Mr. Oldenburgh wrote the same to Mr. Leibnitz himself, December the 8th, 1674, as may be seen in the Commercium, Page the 39th. Therefore Mr. Leibnitz is again mistaken. Furthermore, in the Philosophical Transactions for Jan. and Feb. 1718. Page the 925th, it is said, that M. L' Abbe Conti spent several Hours in looking over the Old Letters and Letter-Books preserv'd in the Archives of the Royal Society, to see if he could find any thing which would make either for Mr. Leibnitz, or against Mr. Newton, and which was omitted in the Commercium Epistolicum; but he could find nothing of this kind.

MOREOVER, Mr. Leibnitz, that he might dismiss the Commercium Epistolicum without any Answer, in his first Letter to Mr. L' Abbe Conti says, *That they who had written against him (that is the Committee appointed by the Royal Society) and had attacked his Candor by hard and ill-grounded Interpretations, should not have the Pleasure of seeing his Answer to the weak Arguments of those who made so ill an Use of them.* Indeed those Interpretations are of no Authority, except what they derive from the

Letters

Of the Invention of the Method of Fluxions. I I

Letters themselves; but that they are ill-grounded Mr. Leibnitz has never yet been able to show.

BUT immediately upon this, Mr. Newton, who could scarcely be persuaded to answer him, in his first Letter to Mr. L'Abbe Conti dated the 26th of February 171 $\frac{1}{2}$ thus wrote, *Mr. Leibnitz hitherto has refused to answer (viz. the commercium Epistolicum) well knowing it to be impossible to confute Matters of Fact. He excuses his Silence in this Matter, pretending, he has not yet seen the Book; and that he has no Leisure to examine it, but that he had desired an eminent Mathematician to take this Trouble upon him.* He also uses a new Pretence that he may not answer it, saying, *That the English shall not have the Pleasure of seeing his Answers to their impotent Reasonings, and proposes new Philosophical Disputes, and Problems to be solved, both which have nothing to do with the Controversy.* But Mr. Leibnitz in his next to Mr. L'Abbe Conti of the 9th of April 1726 continued to excuse himself from giving any Answer; *For, (says he) in order to answer particularly a Book publish'd against me; it will require another Work no less than that is; I must run over a vast Body of Minutes of 30 or 40 Years past, and of which I remember very little. It will be necessary to examine old Letters, a great Part of which are lost, besides that I have preserv'd but a small Part of my Remarks, and the rest are buried in an immense Heap of Papers, which I cannot without much Time and Patience examine. But I have no Leisure at all for these Things, being taken up with Affairs of another Nature.* And, a little after he says, *They ought not to have mangled the Letters; for there are but very few of my Papers, of which I have even the Minutes left.* Thus having weigh'd all Things, and seeing such evident Marks of Malignity and Falshood, I thought it unworthy of me to enter into a Dispute with a Set of Men who have behaved themselves so very ill.

I FIND that in confuting them, it will be difficult to abstain from Reproaches and harsh Expressions, such as their Actions deserve, and I do not desire to exhibit such a Spectacle to the Publick, having a Mind to spend my Time better, which ought to be precious to me, and to despise the Judgment of those who would pronounce Sentence against me upon such a Work; especially since

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the Royal Society hath not seen fit to do it. Thus far *Leibnitz*. He runs off from the first Question into wrangling, and proposing new Questions.

But after his Death (which happen'd in November following) in his Elogy, which was printed in the *Acta Eruditorum*, for the Month of July 1717, his Friends wrote, That he had determin'd to oppose something of his own to the *Commercium Epistolicum* Collinii, et aliorum; and that he had signified to the, *Famous Wolfius*, a few Days before his Death, that he would in very deed refute the *Engliff*, who had discredited him: And that, as soon as he had any Vacancy from his Historical Labours, he would publish some thing in *Analysis* altogether unexpected, and which should have no Affinity to the Inventions hitherto exhibited to the Publick, whether of Mr. *Newton*, or of others.

This they say. But from what has been said already, it is plain that he had no other *Commercium Epistolicum* to publish. And as for his new Invention, which has no Affinity to these Things, this hath nothing to do in the Matter. Passing by therefore these Dreams of sick Men, the whole Question ought to be referr'd to ancient Letters.

In the Beginning of Mr. *Leibnitz*'s Second Letter to M. I. *Abbe Conti* he calls the first Letter of Sir *Isaac Newton* a sort of Challenge from him; and adds, *I will not enter the Lists against his Emissaries, whether you consider the Accuser upon the Foundation of the Commercium Epistolicum, or the Preface full of Acrimony, which another of them has prefixed to the new Edition of his Principia: But when he shall voluntarily appear by himself, I am ready to give him Satisfaction.* To this Mr. *Newton* answered, *That Leibnitz had laid aside old Letters and Papers, and had run off to Questions about Philosophy, and other Matters; and that he had induc'd that Great Mathematician, to whom without any Name, as a Judge, he had attributed that Letter of the 7th of June 1713, as a Second in the Quarrel, challenging the English Mathematicians to solve certain Problems: As if a Duel with himself, or a Battle with his Army of Scholars he boasts of, was a more proper Way to determine the Truth, than an Examination of ancient and authentick Writings; or as if Mathematicks hereafter were to be fill'd with Heroick Actions, instead of Reasonings and Demonstrations.*

LET us now compare the Writings of these two great Men together. The Philosophy which Mr. Newton has handled in his *Principia* and his *Opticks*, is experimental: viz. That which does not confidently assert the Causes of Things, any further than as they may be confirmed by Experiments; and is not to be stuff'd with Hypotheses, which cannot be proved by *Phænomena*. And therefore Mr. Newton in his *Opticks* hath distinguished those Things which are confirmed by Experiments from those which yet remain uncertain: And hath proposed some things of that kind which are dubious, as *Queries* at the End of his *Opticks*. And for the same Reason in the Preface to his *Principia*, when he mentioned the Motion of the Planets, and of the Comets, and of the Moon and Sea, as deduced in that Book from the Theory of Gravity, he adds, *I wish we could derive the rest of the Phænomena of Nature by the same kind of Reasoning from Mechanical Principles: For I am induced by many Reasons to suspect that they may all depend upon certain Forces, by which the Particles of Bodies, by some Causes hitherto unknown, are either mutually impelled towards each other and cohere in regular Figures, or are repelled and recede from each other: Which Forces being unknown, Philosophers have hitherto attempted the Search of Nature in vain.* And towards the End of that Book, in the second Edition, he says, *That for Want of sufficient Experiments in this Matter, he hath not attempted to explain the Laws of the Actions of that Spirit or Agent, by which this Attraction is performed.* And for the same Reason he pronounces nothing concerning the Cause of Gravity; because he had no Experiments or Phænomena at hand, by which he could certainly demonstrate its Cause. And this he had abundantly declared in the very Beginning of his *Principia*, in these Words: *I here design only to give a Mathematical Notion of these Forces, without considering their Physical Causes and Seats.* And, a little after: *I use the Words Attraction, Impulse, or Propensity of any Sort towards a Centre, promiscuously and indifferently one for another; not considering these Forces physically, but mathematically: Wherefore the Reader is not to imagine, that by these Words, I any where take upon me to define the Kind or the Manner of Action, the Causes or the physical Reason thereof: Or that I attribute*

14. Of the Invention of the Method of Fluxions.

but Forces in a true and physical Sense to Centres, (which are only Mathematical Points) when at any Time I have pen to speak of Centres, as attracting, or as endued with attractive Powers. And towards the End of his Opticks: By what efficient Cause these Attractions are performed, I do not here enquire. What I call Attraction, may possibly be effected by Impulse, or by some other Method unknown to us. I would have the Word Attraction so understood here, that it may universally signify any Force whatever, by which Bodies mutually tend to each other, to whatsoever Cause that Force may be attributed: For we must first be taught from the Phenomena of Nature what Bodies attract each other, and what are the Laws and Properties of that Attraction, before it is reasonable to enquire by what efficient Cause this Attraction is perform'd. And a little afterwards, he considers these Attractions, as Forces, which it is certain, from Phenomena, have an Existence in the Nature of Things, although their Causes are yet unknown; and distinguishes them from occult Qualities, which are supposed to flow from the Specifick Forms of Things. And in the Scholium at the End of his Principia, when he had mentioned the Properties of Gravity, he adds this: *Hitherto I have not been able to discover the Cause of these Properties of Gravity from Phenomena, and I frame no Hypotheses, for whatever is not deduced from the Phenomena is to be called an Hypothesis; and Hypotheses whether metaphysical or physical, whether of occult Qualities or mechanical, have no Place in Experimental Philosophy. It is enough that Gravity does really exist, and acts according to the Laws which we have explained, and abundantly serves to account for all the Motions of the Celestial Bodies, and of our Sea.*

AND now, after all these Things which Mr. Newton had on purpose forewarned, who would not wonder, to find him reproached by any one, because he hath not explained the Causes of Gravity, and of other Attractions by Hypotheses: As if it was a Fault to be content with Things we are certain of, and to pass over what are uncertain. And yet the Editors of the *Acta Eruditorum* (for the Month of March, 1716, Pages 142 and 143) have upbraided Mr. Newton with this, that he has denied the Cause of Gravity to be mechanical: And they assert, that

IF this Spirit or Agent, by which Electric Attraction is performed, be not *Aether* or the subtile Matter of *Cartesius*, that it is more contemptible than any Hypothesis; that perhaps it may be the Hylarchic Principle of *Henry More*. Nay, and even Mr. *Leibnitz* himself, in his Treatise *De Veritate Dei*; and, in his Letters to *Hartsoeker*, and elsewhere, has blamed Mr. *Newton*, as if he had made Gravity to be a certain Natural and Essential Property of Bodies; nay, even an occult Quality, and lastly a Miracle. And by these and such like sophistical Cavils, these Men endeavour to persuade their Countrymen, that Mr. *Newton* had but a small Share either of Wit, or Judgment; nor could be the Person who was able to invent so arduous a Matter as the Doctrine of *Infinitesimals*.

INDEED it must be confess'd, there is a very great Difference betwixt Mr. *Newton* and Mr. *Leibnitz* in their Manner of treating upon Philosophy. The former goes as far as the Evidence of *Phænomena* and Experiments leads him; and where that fails him, he stops: The latter abounds altogether with his Hypotheses, and proposes them not to be examined by Experiments, but to be implicitly believed. The One, for want of Experiments which would certainly indicate the Cause of Gravity, does not affirm, whether it be mechanical; or no: The Other, if it be not mechanical, pronounces it to be a perpetual Miracle. The One, (and that also not defining, but inquiring) attributes it to the Power of the Creator, that even the least Particles of Matter are hard: The Other imputes that Hardness of Matter to certain conspiring Motions: And, if its Cause should be supposed any other than mechanical, asserts it ought to be derided as a perpetual Miracle. The One dares not affirm the Animal Motion in Man to be merely mechanical: The Other boldly affirms it to be purely mechanical; since from his Hypothesis *De Harmonia Preestabilita*, the Soul or Mind of Man can never so act upon the Body, as either to assist or impede its Motions. The One asserts, that GOD, (*the God, in whom we live, and move, and have our Being*) to be omnipresent, but yet not as the Soul of the World: The Other indeed affirms him not to be the Soul of the World, but a SUPRAMUNDANE INTELLIGENCE, from whence
it

16 Of the Invention of the Method of Fluxions.

it would seem to follow, that God is not able to do any thing within the Bounds of the Universe, unless by a Miracle altogether incredible. The One advises Philosophers, to proceed from *Phænomena* and Experiments to their Causes, and so on to the Causes of those Causes, 'till at length they arrive at the first Cause: The Other accounts all the Actions of the first Cause for Miracles, and esteems all the Laws impressed upon Nature by the Will of God, as perpetual Miracles, and occult Qualities; and therefore he orders them to be banish'd out of Philosophy. But is this to be our Way of Proceeding? Or are the perpetual and universal Laws of Nature, if they be derived from the Power of God, or from the Action of a Cause yet unknown to us, to be hiss'd at for Miracles and occult Qualities, that is in his Opinion, for Monsters and Absurdities? Or are all the Arguments for the Existence of a God taken from the Phænomena of Nature, therefore to be exploded; because some one may defame them by New and Ignominious Names? Or, Shall Experimental Philosophy, be rejected as superstitious and absurd, because no Man will define without Experiments, nor has any one hitherto been able to prove by Experiments, That all the Phænomena of Nature can possibly be solved by mere Mechanical Causes.

TRULY this Matter deserves both our Mature and Serious Consideration.



ANSWERS to the last ENIGMAS.

- | | |
|-----------------------|-------------|
| 1. Fire. | 4. Poetry. |
| 2. } Fire in a Flint. | 5. A Cock. |
| 3. } | 6. A Clock. |

All the ENIGMAS answered in the Person of a distressed Lover, by I. H. M.

Listen, dear *Phyllis*, to my grievous Moan,
 All Day I sigh, and all the Night I groan :
 And if by Chance, fatigu'd with Grief, I sleep,
 Oppress'd with melancholly Dreams I weep.
 Then wak'd by sudden Crowing of the * Cock, * 5.
 Or by the startling Sound of Neighb'ring * Clock, * 6.
 In wild Confusion tossing too and fro,
 Incessant Miseries I undergo :
 Resolv'd at last to quit my weary Bed;
 I rise with trembling Hands, and aching Head ;
 With Stroke of hard'ned Steel the Flint-Stone ply,
 From whence the * SPARKS in swift Disorder fly. * 2, 3.
 The well-prepared Tinder soon takes * Fire, * 1.
 True Emblem of an amorous Desire :
 By Help of Match a Candle then I light,
 And an Epistle to my Fair One write :
 My Pen abounds in warm * POETICK LAYS, * 4.
 In hopes some tender Sentiments to raise.
 But if my Plaints her Pity cannot move,
 I'll study *Quia's* Remedy of Love.

All the Enigmas answered by RUSTICUS.

SOON as the Morning Light begins to peep,
 Th' industrious Ploughman wak'd from his my Sleep.
 Harks to the frequent Crowing of the * Cock, * 5.
 And thereby guesses what may be the * Clock : * 6.
 C Goes

18 *The Geographical PARADOX answered.*

Goes forth unto the Tillage of the Soil,
 And with repeated *SONGS bequiles the Toil. * 4.
 When tir'd sits down his dewy Face to wipe,
 First fills, and then prepares to light his Pipe :
 By Force of Steel abroad he quickly calls
 The subtle *SPARKS, that sleep in flinty Walls, * 2: 3.
 Those, catch'd by Tinder, set the Weed on *FIRE, * 1.
 And he by Smbaking, does new Strength acquire.

Four of the Enigmas answered by W. W.

THE *FIRE is good, let's have another Glass, * 1.
 With tuneful *SONGS the fleeting Minutes pass ; * 4.
 Although the *CLOCK's struck Ten, we'll not away, * 6.
 'Till crowing *COCKS proclaim th' Approach of Day. * 5.

The Geographical Paradox, answered by E. H-x-l-y.

IF the two Places are East and West of each other, they are in the same Parallel of Latitude, (being parallel to the Equator, which is an East and West Circle) therefore to steer a Ship East or West is keeping always in the same Parallel, and describing the Arch of a lesser Circle, which is not the nearest Distance. For it is a *Postulatum* in EUCLID, *That a right Line is the shortest that can be drawn betwixt two given Points.* Now the larger any Circle's Diameter is, the nearer does the Periphery approach to a right Line ; and consequently an Arch of a greater Circle intercepted between two Places must be shorter than if it were the Arch of a lesser Circle. But this will more evidently appear by an Arithmetical Computation.

AND, 1. For the Distance in the Parallel of Latitude of the two given Places lying under the Arctick Circle

or Latitude of $66 : 30$ North, whose Difference of Longitude is 100 Degrees.

P R O J E C T I O N.

Draw the Primitive Circle ZONH, (*Fig. 1.*) which let be the Meridian of the Westermost Place, and draw H

O for the Horizon thereof, then set of the Chord of $66 : 30$ from O to P, so shall O P be the Elevation of the Pole in both Places, and consequently Z will represent the Westermost Place, then with the half Tangent of 10 Degrees set from

from the Centre C Eastward to D, upon the Equinoctial, so shall E D be the Difference of Longitude between them, = the Angle E P D, a Circle being drawn thro' the three Points P D and S. will represent the Meridian of the Eastermost Place, and with the Co-Tangent of the Latitude draw the Parallel Z m B, so shall B represent the Eastermost Place, and the Distance in that Parallel is represented by the Arch of the lesser Circle Z m B, to find the said Distance in that Parallel, this is an universal Cannon.

As Radius : { to 60 Miles the Measure of } :: { Cosine of }
 As 90 d — : { a Degree on the Equator } :: { the Lat. }
 : to 23.92 Miles, which answereth to a Degree in the Paral-

lel of 66 : 30 or under the Arctick Circle, which multi-

ply'd by 10: Degrees the Difference of Longitude, the Product is 2392. Miles the Distance counted upon the Arch of the lesser Circle or Parallel which a Ship wou'd describe by sailing from the one Port to the other upon an East or West Course.

2. To find the Angles of Position or Bearing, their Distance in the Arch of a great Circle and the greatest Latitude the Arch shall pass through.

In the foregoing Scheme through the two given Places Z and B draw the Great Circle ZBN, then will Z n B be the Distance of the two Places on the Arch of a Great Circle, and consequently their nearest Distance, the Angle n B P and the Angle n Z P, the Angles of Position, to find each of which, let fall the Perpendicular P n which divides the Equicrural Triangle Z P B into two equal right-angled Triangles (viz.) Z n P and B n P, and in the Triangle Z n P

there are given PZ = 23 : 30 = the Complement of the

given Latitude, and the Angle Z P n = 50 = half the Difference of Longitude, between the two Places, to find the Angles n Z P, n B P the Angles of Position, and the Arch Z n B their Distance on the Arch of a Great Circle, as also the Perpendicular P n the Complement of the greatest Latitude that the Arch of Distance Z n B passeth through.

Then

Then as the Co-tangent of the $\angle ZPn = 50 : 0$ ^d ——— "9.623813
is to Radius ——— "10.000000

so is the Co-sine of $PZ = 23 : 30$ ^d ——— "9.962398

To the Co-tangent of the $\angle PZn = 65 : 22$ ^d "10.338585

whose Complement $24 : 38$ is the Angle of Position at each Place.

As Radius ——— "10.000000

Is to the Sine of $ZP = 23 : 30$ ^d ——— "9.600700

So is the Sine of the $\angle ZPn = 50 : 0$ ^d ——— "9.884254

To the Sine of $Zn = 17 : 47$ half their Distance "9.484954
and this doubled is 35 Degrees 34 Minutes, or 2134 Miles,
their true Distance BnZ on the Arch of a great Circle.

As the Co-tangent of $ZP = 23 : 30$ ^d ——— "10.361698
is to Radius ——— "10.000000

so is the Co-sine of the $\angle ZPn = 50 : 0$ ^d ——— "9.808067

to the Tangent of $Pn = 15 : 37$ ^d ——— "9.446369

whose Complement to 90 Degrees, viz. $74 : 23$ is the
Arches greatest Latitude. So that the Ship must sail
North 24 Deg. 38 Min. Westerly 1067. Miles till she
comes into the Latitude of 74 Deg. 23 Min. North, and
then South 24 Deg. 38 Min. Easterly 1067. Miles to ar-
rive at her intended Port. Hence it plainly appears by
comparing this Distance on the Arch of a Great Circle,
with the former Distance in the Parallel, or East and
West Circle, that the latter is 258 Miles more than the
former.



A Calculation of a Partial Eclipse of the MOON, which will happen on Sept. 21, 1735. for the Meridian of YORK, from STREET's Astronomia Carolina. By E. H-y.

	Days Signs	Ho De	M '	S "
E qual Time of the true ☉ at York, Sep- tember 21, 1735. in the Morning	20	13	35	50
The Mean Anomaly of the Sun	3	2	32	00
The Mean Anomaly of the Moon	2	1	48	05
The true Place of the Sun	♈	8	16	43
The true Place of the Moon	♊	8	16	43
The Place of the Ascending Node	♊	15	44	47
The Argument of Latitude	11	22	31	56
The true Latitude South descending			38	56
The Reduction add			1	41
The Time of Reduction subtract			3	27
The Equal Time of the true Ecliptick ☉	20	13	32	23
The true Hourly Motion of the Sun			2	28
The true Hourly Motion of the Moon			31	32
The Hourly Motion of the Moon from Sun			29	4
The Semi-Diameter of the Sun			15	55
The Semi-Diameter of the Moon			14	47
The Horizontal Parallax of the Sun				15
The Horizontal Parallax of the Moon			54	44
The Horizontal Parallax of the Sun and Moon			54	59
The Sun's Semi-Diameter subtract			15	55
The apparent Semi Diam. of Earth's Shadow			39	3
The Moon's Semi-Diameter add			14	47
Sum of the Semi-Diam. of ☾ and Earth's Shad.			53	50
The Moon's Latitude subtract			38	56
The Parts deficient			14	58
The Digits eclipsed		6	3	5
The Time of Reduction add			3	27
The equal Time of greatest Obscuration	20	13	39	17
The Equation of Natural Days add			10	38
The apparent Time of the greatest Obscuration	20	13	49	55
The Motion of half Duration			36	14
The Time of half Duration		1	16	51
The Beginning of the Eclipse	20	12	33	4
The Middle	20	13	49	55
The End	20	15	6	46
The whole Duration.		2	23	42

So that the Beginning of the Eclipse } H. ' " }
 is on September 21, 1735. at } 12 : 33 : 3 } In the
 The Middle at } 1 : 49 : 55 } Morning
 The End at } 3 : 6 : 46 } at the City
 Duration } 2 : 33 : 42 } of York.

22 New Par. propos'd, and Pr. Qu. L. D. answered.

Two New Geographical Paradoxes propos'd by E. H-x-l-y.

P A R A D O X *the 1st.*

ON the terraqueous Globe two Places lye
Due East and West : Now query why
Their nearest Distance North and South direct
Should be : Let wiser Heads than mine detect.

P A R A D O X *the 2d.*

IT is required to find upon what Place of the Terra-
queous Globe a Ship may sail 185. Miles on a due
South Course, to raise the Pole only one Degree.

The Prize Question in the Lady's Diary, 1735. answered.

PERhaps it may not be disagreeable to some of my Cor-
respondents to give the Solution to the Prize-Question
in the Lady's Diary for the current Year in this Place

Through the Point of Interfection S, (*Vide Fig. 2.*) draw
the Lines *wp, mn, tq*, parallel to the Sides *AC, AB*, and
BC. Then by the *4th Prop.* of the *6th Lib.* of *Euclid*,
we shall have the following Analogies, *vis.*

$$\begin{aligned} \text{As } Sp : Sw :: Cc : Aa. \\ nS : mS :: Aa : Ba. \\ tS : qS :: Bb : Cb. \end{aligned}$$

Now multiply all the Terms together, and we shall have
 $pS \times wS \times tS : Sw \times mS \times qS :: Cc \times Aa \times Bb : Aa \times Ba \times Cb$

Again by the same *4 Prop. 6 Lib. Euc.*

$$\begin{aligned} \text{As } qS : tS :: nS : wt \\ pS : Sw :: mS : wt \end{aligned} \quad \left. \vphantom{\begin{aligned} \text{As } qS : tS :: nS : wt \\ pS : Sw :: mS : wt \end{aligned}} \right\} \text{Consequently}$$

$$\frac{St \times nS}{qS} = \frac{Sw \times mS}{pS}$$

Which reduc'd gives $St \times nS \times pS = Sw \times mS \times qS$.
And hence by Equality of Proportion in the former Ana-
logy $Aa \times Bb \times Cc = Ac \times Cb \times Ba$. *Q. E. D.*

A N S W E R S

ANSWERS to the last Arithmetical QUESTIONS.

QUESTION the 1st, answered by W. W.

Put $b = 2000.$ } First Man's Share $= a^2.$
 $c = 362.$ } Third Merchant's $= e^2.$
 $d = 341.$ } Second's Share $= b - a^2 - e^2.$

Then $\left. \begin{array}{l} 1 \quad b - e^2 - e = a^2 + c \\ 2 \quad b - a^2 - a = e^2 + d \end{array} \right\} \text{By the Question}$

$\left. \begin{array}{l} 3 \quad b - e - c = e^2 + a^2 \\ 4 \quad b - a - d = e^2 + a^2 \end{array} \right\} \text{Ergo}$

$4, 5 = 6 \quad a = c - d + e = 21 + e.$

$6 \odot 2 \quad 7 \quad a^2 = e^2 + 42e + 441.$

In the first Step for a^2 substitute its Value.

$8 \quad b - e^2 - e = c + e^2 + 42e + 441.$

$9 \quad e^2 + e^2 + 43e = b - c - 441 (= 1197.)$

And by converging Series we shall find $e = 9.$ hence $e^2 = 729.$ The third Merchant's Gain; $a^2 = 900.$ The first Merchant's, and the Second's Gain $= 371.$ Crowns.

QUESTION the 2d, answered by R. P.

Let $a = A^1.$ } $b = 252.$ } 1. $aeu = b.$
 $e = B^1.$ } $c = 756.$ } 2. $eu y = c.$
 $u = C^1.$ } $d = 336.$ } 3. $uya = d.$
 $y = D^1.$ } $g = 432.$ } 4. $yac = g.$

By the first Step. $e = \frac{b}{au}.$ By 2d. $e = \frac{c}{uy}.$ Ergo $\frac{b}{au} =$

$\frac{c}{uy};$ And $y = \frac{cu}{b},$ By 2d. $y = \frac{c}{eu}:$ and by 3d. $y = \frac{d}{ua}.$

Consequently $\frac{c}{eu} = \frac{d}{ua},$ and $e = \frac{ca}{d}.$ Now if in the Fourth

Step for y and e we substitute their respective Values above found: Then $\frac{ca}{b} \times \frac{ca}{d} \times u = g.$ That is $\frac{c^2 a^2}{bd} = g.$

Whence $a = \sqrt[3]{\frac{bdg}{ec}} = 4; e = 9; u = 7; y = 12;$

QUESTION

24 ANSWERS to the last Arithmetical Questions.

QUESTION the 3d, answered by W. W.

PUT a = Number of Men $\left\{ \begin{array}{l} b = 10. \\ e = \text{the Sum of Money} \end{array} \right. \left\{ \begin{array}{l} c = 20. \end{array} \right.$

Then $\frac{e}{a+2} = \frac{e}{a} - b$. Or $ae = ae + 2e - ba^2 - 2ba$

and $\frac{e}{a-2} = \frac{e}{a} + c$. Or $ae = ae - 2e + ca^2 - 2ca$

By the first Step we have $2e = ba^2 + 2ba$.

And by the Second. $2e = ca^2 - 2ca$;

Hence $ba^2 + 2ba = ca^2 - 2ca$; $ba + 2b = ca - 2c$.

$ca - ba = 2c + 2b$; $a = \frac{2c+2b}{c-b} = 6$. The Number

of Men, and $e = 240$. The Number of Pounds.

QUESTION the 4th, answer'd by I. N.

Let $d = 143$; $a = AC$ (in Fig. 3.) $a + d = BC$; Then is

$AB = \sqrt{2a^2 + 2da + d^2}$ by the 47. 1. Euc. but the Triangles ACB ; ADC ; BDC ; are all similar, Hence

$\sqrt{2a^2 + 2da + d^2} : a :: a : \frac{aa}{\sqrt{2a^2 + 2da + d^2}} = AD$. And

$\sqrt{2a^2 + 2da + d^2} : a + d :: a + d : \frac{a^2 + 2da + d^2}{\sqrt{2a^2 + 2da + d^2}} = BD$.

But by the Question

As $2 : 3 :: \frac{aa}{\sqrt{2a^2 + 2da + d^2}} : \frac{a^2 + 2da + d^2}{\sqrt{2a^2 + 2da + d^2}}$. And multi-

plying Extreams and Means together we have $3aa = 2a^2 + 4da + 2d^2$. Or $a^2 - 4da = 2d^2$. and by Extraction of

the Root $a = \sqrt{6d^2 + 2d} = 636.27$ Yards; = AC . And

$BC = 779.277$; $AB = 1006.04$;

The greater Segment $BD = 603.62$ { Yards.

The lesser $AD = 402.42$ }

The Triangles Area = 147918.02 Square Yards, equal to 51 Acres, and 35.63 Perches.

The Geometrical Construction of this Question may be thus effected. In Fig. 3. make $BH = 3$. and $HG = 2$. ; and upon BG as a Diameter, describe the Semi-Circle GFB . Upon H erect the Perpendicular HF and draw GF , and

and BF and produce it towards C, also produce BG towards A : Then make FI = FG, and draw GI ; again set off the Given Difference of the Legs from B to E and draw EA parallel to IG until it intersect BG in A : From A draw AC parallel to GF, until it intersect BF continued as in C ; Then will ABC be the Triangle required. From hence it is easy to deduce a Trigonometrical Solution.

QUESTION the 3th, answered by R. G.

SUPPOSE the Thing done (as in Fig. 4.) and the Sides of the Triangle ABC being given, its Area will be

found = 2498.3, and the Angle BAC = 78° 32' therefore the Area of the Triangle AHG must be = 1498.98 ; and EF being drawn parallel to BA, ED will be found = 9.98 which makes EA = 19.98 ; Put this = a . and ED = p = 50. ; AG = x ; c = 1498.98 then is HO = $\frac{2c}{x}$, and by similar Triangles, as $a + x : p :: x : \frac{2c}{x}$.

Hence $px = \frac{2ca + 2cx}{x}$ $px^2 - 2cx = 2ca$, and $x = \sqrt{2ca + \frac{c^2}{p^2}}$
 $+\frac{c}{p} = 76.01 = AG$; and AH = 40.26 ; HG = 78.4

QUESTION the 6th, answer'd by I. N.

DRAW the Lines (as in Fig. 5.) and put $b = AC$ the Hypotenuse ; $s = DE = Dp$ the Side of the inscribed Square ; $a = BS$ the Perpendicular let fall from B ; $e = Cw$ the Difference of the Segments of the Base. Then $Bt = a - s$; and by similar Triangles, As $a - s : s :: a : b$,

hence $ba - bs = sa$; and $a = \frac{bs}{b-s}$; But $\frac{b+e}{2} = Cs$;

and $\frac{b-e}{2} = As$; Now because the Triangle ABC is

right-angled we have $AS \times CS = BS^2$. that is $\frac{bb-ee}{4} = aa$

But a^2 also is = $\frac{b^2s^2}{b^2-2bs+s^2} = \frac{b^2-e^2}{4}$. which being
 D reduced

reduced and the Root extracted we have

$$e = \frac{\sqrt{b^4 - 2b^2s - 3b^2s^2}}{b^2 - 2bs + s^2}$$

This also may be solv'd by a Quadratic Equation when the Sides of the inscribed Square are parallel to the Legs of the primary Triangle. Thus, (*In Fig. 6.*) Produce the Side of the Square BC to G, and from E erect EG perpendicular to EF, meeting BG in G; and let fall EH perpendicular to BG. Then call AD = AB, a ; FE, b ; CG, x ; CE, y ; And BG is $a + x$; EC = $b - y$; For the Triangles CBF, CEG, CHE, EHG are similar, also the Triangles CBF, EMG are equal Because BC = EH. Then by similar Triangles, as a (CB) : $b - y$ (CF) :: y (CE) : x (CG). Ergo $ax = by - y^2$. But $\overline{GC}^2 = \overline{GE}^2 + \overline{CE}^2$, that is $x^2 = b^2 - 2by + y^2$. Or $\frac{b^2 - x^2}{2} = by - y^2 = ax$. therefore $b^2 - x^2 = 2ax$; and $x = \sqrt{b^2 + a^2} - a$,

QUESTION the 7th, answered by R. F.

HAVING supposed the Problem resolved draw CD parallel to PM, and put $a = AB$; $b = AD$; $c = DC$; $d = DB$; $x = AP$; $z = PE$; $y = PM$; $u = PF$; $PB = a - x$; Then the similar Triangles APE, ADC. And BDC, BPF. will give these Proportions.

As AP (x) : PE (z) :: AD (b) : DC (c). Ergo $bz = cx$. As BD (d) : DC (c) :: BP ($a - x$) : PF (u). and $du = ac - cx$. But by the Conditions of the Problem we have PE (z) : PM (y) :: PM (y) : PF (u). hence $zu = y^2$ Now

by the first Proportion $z = \frac{cx}{b}$; and by the Second $u = \frac{ac - cx}{d}$; In the third Proportion for z and u substitute

their Equals, and we shall have $\frac{ac^2x - c^2x^2}{bd} = yy$. Or

$x^2 - ax + \frac{b^2y^2}{c^2} = 0$; which is an Equation belonging to an Ellipsis, of which AB is the Transverse Diameter, and

O its Centre : For by the common Property of the Ellipsis

$$AP \times PB : PM^2 :: AO^2 : KO^2, \text{ and}$$

$$AD \times DB : DC^2 :: AO^2 : KO, \text{ consequently}$$

$AP \times PB : PM^2 :: AD \times DB : DC^2$. that is in Algebraic Terms $ax - x^2 : y^2 :: bd : c^2$. and by multiplying

Extreams and Means we have $\frac{ac^2x - c^2x^2}{bd} = yy$. The very

same Equation as that before found. Q. E. D.

QUESTION the 8th, answered by I. T.

FIRST, For the Geometrical Construction set off (In Fig 8.) the Latitude and Azimuth as usual, then because the Sum of the Declination and Altitude is 59 Degrees the Sum of their Complements is 121 Degrees; Lay of the

said 121 : 00 from Z to x, and draw the Meridian PxS, through the Centre and the Point x draw fm, and whatever f x measures upon the half Tangents, lay of the same upon the Tangents from the Centre to m; Then setting one Foot of the Compasses in m, extend the other to E, and where it cuts the Azimuth Circle ZxN as at O will be the Point through which the Meridian P O S must pass, which will complet the Triangle.

TRIGONOMETRICAL CALCULATION.

In the Triangle N x S are given NS = 37 : 00, and

Nx = 59 : 00, and the Angle SNx = 43 : 0 To find Sx and the Angle SxN. Then in the Triangle P O x are given Px = to the Complement of Sx to 180 Degrees, and the Angle P x O = $\angle SxN$. Now because Zx is = Complements of the Altitude and Declination, and P O + Z O = also to the Complements of the Altitude and Declination, Take away Z O common to both, and there remains x O = P O; and consequently the Angle x P O = $\angle P x O$. But the two Sides being equal, a Perpendicular let fall from O upon Px as O v will bisect the Side Px; Hence Pv and the Angle, at P being given, P O may be readily found, which is the Complement of the Declination, and from thence all the rest.

D

ALGE

ALGEBRAIC CALCULATION.

Put $n = \text{Nat. Sine of } 121^\circ : - = P\odot + Z\odot = .8572$
 $n = \text{Co-Sine of the same} = .5150$

$c = \text{Versed Sine of the } \angle PZ\odot 137^\circ : - = 1.7313$

$b = \text{Nat. Sine of } ZP = 37^\circ \text{ Degrees} = .6018$

$d = \text{the Co-Sine of the same} = .7986$

$x = \text{Nat. Sine of } Z\odot ; \sqrt{1-x^2} = \text{its Co-Sine.}$

Then by Page the 370th of *Ronayne's* Algebra the Versed Sine of $P\odot$ is $= 1 - mx + \sqrt{n^2 - n^2 x^2}$. And the Co-Sine of the Difference of the Sides $Z\odot, ZP$ by Page the 369th of the same Author is $= bx + \sqrt{d^2 - d^2 x^2}$. Consequently the Versed Sine of their Difference is equal $1 - bx - \sqrt{d^2 - d^2 x^2}$. Lastly by Theorem at Page the 120th, Volume the 2d. of *Ozanam's* *Cursus*, $bx : 1 :: 1 - mx + \sqrt{n^2 - n^2 x^2} - 1 + bx + \sqrt{d^2 - d^2 x^2} : c$ and multiplying Extremes and Means we have $bcx = bx - mx + \sqrt{n^2 - n^2 x^2} + \sqrt{d^2 - d^2 x^2}$. Let $p = bc + m - b$; Then is $px = \sqrt{n^2 - n^2 x^2} + \sqrt{d^2 - d^2 x^2}$. And $p^2 x^2 = n^2 - n^2 x^2 + d^2 - d^2 x^2 + 2\sqrt{d^2 n^2 - d^2 n^2 x^2 + d^2 n^2 x^4}$. Again put $-q = -n^2 - d^2$; $q = p^2 + n^2 + d^2$. Then $s x^2 - q = 2\sqrt{d^2 n^2 - d^2 n^2 x^2 + d^2 n^2 x^4}$; and by Involution $s^2 x^4 - 2q s x^2 + q^2 = 4d^2 n^2 - 8d^2 n^2 x^2 + 4d^2 n^2 x^4$. By Transposition $\left. \begin{aligned} s^2 x^4 - 2q s x^2 + q^2 &= 4d^2 n^2 - 8d^2 n^2 x^2 + 4d^2 n^2 x^4 \\ - 4d^2 n^2 x^4 + 8d^2 n^2 x^2 &= -q q \end{aligned} \right\}$ And by Substitution $x^4 - 2fx^2 = -b$; and extracting the Root $x =$

$\sqrt{f + \sqrt{f^2 - b}} = .7116$ the Natural Sine of $45 : 22$

the Co-altitude $Z\odot$. So the Altitude was $44 : 38$; and

the Sun's Declination $14 : 22$ North; which was on the 18th Day of April, and the Time was 2 o'Clock in the Afternoon.

QUESTION the 9th, answered by R. D.

LET $a = CB 24$. Inches; $b = AB = 30$.; $d = .7854$; $k = ED$; (as in Fig. 9.) then by the Property of the Parabola

Parabola $ad : b :: ax : \frac{bx^2}{a^2} = AD$; consequently BD

$= b - \frac{bx^2}{a^2}$. And by Theorem the 15th of Ward's Ar-

ithmetick of Infinites $\frac{4dba^2}{3} + \frac{4dbax}{3} - \frac{4dbx^3}{3a} - \frac{4dbx^4}{3a^2}$

= to the Solidity of the Conic-Frustum CEDPSB. The

Fluxion of this, viz. $\frac{4dbax}{3} - \frac{12dbx \cdot x}{3a} - \frac{16dbx^3 \cdot x}{3a^2} = 0$,

and by Multiplication, Transposition, &c. $4x^3 + 3ax^2 = aaa$.

Therefore x will be found = 10.9298 Inches, and the lesser Diameter = 21.8596, its Height equal to 23.7781 Inches, and the Content 103.242 Wine Gallons. Which was required to be found.

QUESTION the 10th answered by R. W.E.f.f.b.

DRAW the Lines (as in the Scheme Fig. 10.) and let

$HF = GF = DC = d$; $AC = a$; $AP = x$; $PM = y$;

Then by the Nature of the Question it will be, as,

$AC (a) : DC (d) :: AP (x) : HL = \frac{dx}{a}$. Wherefore LI

$= 2d - \frac{dx}{a} = \frac{2ad - dx}{a}$ and by the Property of the

Circle $LN^2 = \frac{2ad^2x - d^2x^2}{aa} = PM^2 = y^2$. Conse-

quently the Locus sought is an Ellipsis, whose conjugate Semi-Axes are AC and CD , for by the known-Property of the Ellipsis it will be

As $\frac{AC^2}{a^2} : \frac{CD^2}{d^2} :: APx \frac{AC + PC}{2a - x} : PM^2$.

Hence $\frac{2ad^2x - d^2x^2}{aa} = y^2$. the very same Equation, as

before found.

QUESTION the 11th, answered by I. T.

IT is evident that a great Circle drawn thro' K perpendicular to upm will bisect pm in q (Vid. Fig. 11.) because by the Qu. the Triangle pKm is equicrural, Then in the oblique Spherical

30 ANSWERS to the last Arithmetical Questions.

rical Triangle Pmp are given $Pm = 57 : 0$, and $Pp = 36 : 00$ and the contained Angle $40 : -$ to find $pm = 35 : 6$ the Distance of the Ports from each other and the Angle $Pmp = 41 : 7$

In the Right Angled Triangle $m \phi n$ are given $m \phi = 17 : 33$ and the $\angle \phi mn = 41 : 7$ to find $mn = 22 : 46$ and $\phi n = 14 : 45$ and the $\angle m n \phi = 51 : 11 = \angle Pnx$

From the Side Pm subtract mn , remains $Pn = 34 : 14$

In the Right Angled Triangle Pnx are given Pn and the $\angle Pnx$ to find $Px = 26 : 00$ and $nx = 23 : 6$

In the Right-Angled Triangle PKx are given $PK = 108 : 00$ and $Px = 26 : 00$ to find $Kx = 110 : 7$. From Kx subtract $\phi n + nx$ remains $K \phi$

In the Right angled Triangle $K \phi m$, given $K \phi = 72 : 16$ and $\phi m = 17 : 33$ to find $Km = Kp$ the Distance of the Island from each of the Ports $= 73 : 7$

Lastly, In the Oblique Triangle KpP are given $KP = 108 : 0$ and $Pp = 36 : 00$ & $Kp = 73 : 7$ to find the Angle $KPp = 14 : 54$ The Difference of Longitude between the Island and the Port p . and adding to it the Angle pPm gives the Difference of Longitude betwixt the Island and the Port $m. = 54 : 54$. Q. E. I.

QUESTION the 12th, answered by J. T.

LET Mm , Ss (in Fig. 12.) represent the Transverse and Conjugate Axes of the Ellipsis which we seek, Qb , AR the two Conjugate Diam. given; and the Angle contained $ACb = 68 : -$ Degrees, it is demonstrated by the Writers on Conicks,

nicks, that if a Tangent be drawn to any Point of an Ellipsis, as A and the Diameter AR be drawn, and any other 2 Conjugate Diameters be produced 'till they meet the said Tangent as in D and E That $DA \times AE =$ to the Square of the Semidiameter CQ. the Conjugate to CA, Hence it is plain that if AO be erected perpendicular to DE and $= CQ$ That DOE will be a right angled Triangle, and describing a Circle upon DE as a Diameter, it will pass thro' the Point O, and likewise thro' the Centre C, because the $\angle DCE$ is also a right Angle. Draw now the Lines as in the Scheme, viz. CB perpendicular to DE, AP perpendicular to CE, and Af perpendicular to CD, then because CA is known to be 27.5 Feet, and the $\angle CAB = \angle ACb = 68$ Degrees, CB will also be known $= 25.5$ which call b , and $BA = 10.3 = c$; Put $AK = x$; $AO = CQ = 41. = a$; Then $b^2 + c^2 + 2cx + x^2 = (CK^2 = KO^2 =) a^2 + x^2$.

Ergo $x = \frac{a^2 - b^2 - c^2}{2c} = 44.9$; and the Radius of the

Circle $= 60.8$; To KE add KB, and subtracting it from the same gives $DB = 5.6$ and $BE = 116$. and CB being before known we may find $CD = 26.1 = p$; and $CE = 118.8 = q$; But the similar Triangles DCE, DfA give this Proportion, viz. As $DE : DC :: DA : Df = 3.4$ and As $DE : CE :: DA : fA = CP = 15.5$ From CD. subtract Df remains Cf $= AP = 22.7$ which call n ; CP, m ; the Semi-transverse Diameter r ; the Semi-Conjugate c ; Then it's evident,

that because the Subtangent PE is $= \frac{r^2 - m^2}{m}$ as is de-

monstrated by Ward, Page the 371. and $fD = \frac{c^2 - n^2}{n}$.

That therefore $CE = m \frac{r^2 - m^2}{m} = \frac{r^2}{m} = q$. and

$CD = n \frac{r^2 - n^2}{n} = \frac{r^2}{n} = p$.

Consequently $r = \sqrt{mq} = 42.9$ and $c = \sqrt{np} = 24.4$

Now for the Geometrical Construction.

Draw the Diameters AR. Qb, making the given Angle ACb, produce CA and on it take $AV =$ to a 3d Proportional

portional to CA and Cb: And having drawn thro' A the right Line AE parallel to Qb, from the Point n the Middle of CV Erect the Perpendicular nK meeting AE in K; upon the Centre K thro' C and V describe a Circle cutting AE in the Points E and D. Through which Points and the Centre C draw EC, DC producing them indefinitely. Then draw AP, Af parallel to CD, CE, and having taken Cm a mean Proportional between CP and CE, and Cs a mean Proportional between Cf and CD; make CM = Cm and Cs = CS. I say then that Mm and Ss will be the Transverse and Conjugate Axes of the Ellipsis.

QUESTION the 13th, answered by J. N.

$$\begin{array}{lcl} \text{Put } Ds = b = 318.75 & DG = x; & \\ Dn = d = 468.75 & DH = y; & \left. \begin{array}{l} \\ \\ \end{array} \right\} \text{Fig. 13.} \\ Dw = e = 81.25 & \text{Radius} = 1. & \end{array}$$

$$\text{Then is } Gw = \sqrt{x^2 - c^2}, GS = b - x, Hn = d - y, \\ Hw = \sqrt{y^2 - c^2}.$$

$$\text{As } x : 1 :: c : \frac{c}{x}. = \angle DGw. = \angle AGS. \text{ Ergo}$$

$$\angle GAS = \sqrt{1 - \frac{c^2}{xx}}$$

$$\text{As } Gw : wD :: GS : SA. \text{ i.e. } \sqrt{x^2 - c^2} : c :: b - x ; \\ \frac{cb - cx}{\sqrt{x^2 - c^2}} = AS = SB, \text{ Ergo } AB = \frac{2cb - 2cx}{\sqrt{x^2 - c^2}} \text{ and by a}$$

$$\text{like Process we shall find } BC = \frac{2cd - 2cy}{\sqrt{y^2 - c^2}}.$$

$$\text{As } Dw : DG :: AS : AG. \text{ That is } c : x :: \\ \frac{cb - cx}{\sqrt{x^2 - c^2}} : \frac{cbx - cx^2}{c\sqrt{x^2 - c^2}}, = AG. \text{ Ergo } Aw = \frac{bx - x^2}{\sqrt{x^2 - c^2}}$$

$$+ \sqrt{x^2 - c^2} = Cw = \frac{dy - y^2}{\sqrt{y^2 - c^2}} + \sqrt{y^2 - c^2} :$$

$$\text{Now multiply each Part of the Equation by its respective Denominator, and reducing we have } \frac{bx - c^2}{\sqrt{x^2 - c^2}} = \frac{dy - c^2}{\sqrt{y^2 - c^2}},$$

Now involve both Parts of the Equation, and multiply cross-

crossways, and reducing it we have $b^2 y^2 x^2 - 2bc^2 y^2 x + c^4 y^2 - b^2 c^2 x^2 + 2bc^4 x = d^2 y^2 x^2 - 2dc^2 yx^2 + c^4 x^2 - d^2 c^2 y^2 + 2dc^4 y$.

Again in the Triangle ABC we have As $\angle BAC : BC ::$

$$\angle BCA : BA. \text{ Or } \frac{\sqrt{x^2 - c^2}}{x^2} : \frac{2cd - 2cy}{\sqrt{y^2 - c^2}} :: \frac{\sqrt{y^2 - c^2}}{y^2} ;$$

$\frac{2cb - 2cx}{\sqrt{x^2 - c^2}}$ Reduce this, and multiplying Extreams and

Means we have $dx = by$. and $x = \frac{by}{d}$. Now for x put its

Value in the above Equation, and $\frac{b^4 y^4}{d^2} - \frac{2b^2 c^2 y^3}{d} + c^4 y^2 -$

$$\frac{b^4 c^2 y^2}{d^2} + \frac{2b^2 c^4 y}{d} = b^2 y^4 - \frac{2b^2 c^2 y^3}{d} + \frac{c^4 b^2 y^2}{d^2} - d^2 c^2 y^2$$

$+ 2dc^4 y$. and reducing all to one Denomination, and dividing by y , and transposing the Terms, we have this

$$\text{Equation } \begin{array}{r} -b^4 y^3 \\ + c^4 b^2 \\ + b^4 c^2 \\ - c^4 d^2 \\ - d^4 c^2 \end{array} y = \begin{array}{r} 2db^2 c^4 \\ - 2d^3 c^4 \end{array} \}$$

Or by Substitution $y^3 - py = -q$; In Numbers $y^3 - 21197y = -398439$. And by the Method of converging Series $y = 135.1$; $x = 92.15$; And hence the Sides of the Triangle are, viz. AC = 1050. AB = 850. BC = 500. Chains.

QUESTION the 14th, answered by E. H-x-l-y.

Put BC = $b = 46$. Leagues.

EB = $c = 20$.

AD = $d = 70$.

} See Fig. 14.

N. Sine $\angle GSB = s = .7729 = 50 : 37$

$\angle GBS = p = .6345$ its Co-sine.

Bp = x . Then is Cp = $b - x$.

and AK = $d - b + x = a - x$ by Substitution

$r = \text{Radius} = \text{Unity}$.

34 ANSWERS to the last Arithmetical Questions.

First $\sqrt{c^2 - x^2} = Ep$, which put $= b$. and then $b^2 = c^2 - x^2$,

$$\text{As } x : c :: d : \frac{dc}{x} = AE. \text{ Ergo } AB = \frac{dc + cx}{x}$$

$$\text{As } x : b :: d : \frac{db}{x} = DE \text{ Conf. } Dp = \frac{db + bx}{x} = KC$$

Hence $KC^2 = \frac{d^2 b^2 + 2db^2 x + b^2 x^2}{x^2}$. And $KA^2 = a^2 + 2ax + x^2$. Consequently (for b^2 restoring its Value $c^2 - x^2$.)

$$CA^2 = \frac{d^2 c^2 - d^2 x^2 + 2dc^2 x - 2dx^3 + c^2 x^2 + a^2 x^2 + 2ax^3}{x^2}$$

$$\text{and } CA = \sqrt{\frac{d^2 c^2 - d^2 x^2 + 2dc^2 x - 2dx^3 + c^2 x^2 + a^2 x^2 + 2ax^3}{x^2}}$$

Substitute this last Surd equal to k in order to contract the Work. Again,

$$\text{As } c : r :: b : \frac{br}{c} = N. S. \angle E Bp. \text{ and } As k : \frac{br}{c} :: b$$

$$\frac{rbh}{kc} = N. S. \angle GAB.$$

$$\text{As } s : \frac{dc + cx}{x} :: \frac{rbh}{kc} : \frac{rbhd + rbbx}{skx} = BS.$$

$$\text{As } r : \frac{rbhd + rbbx}{skx} :: p : \frac{bpbx + bpbx}{skx} = GS$$

$$\text{As } a + x : k :: b - x : \frac{kb - kx}{a + x} = CS \text{ by similar Tri-}$$

$$\text{angles. Ergo } GC = \frac{kb - kx}{a + x} - \frac{bpbx - bpbx}{skx} \text{ and by Re-}$$

$$\text{duct. } GC = \frac{sk^2 bx - sk^2 x^2 - bpbda - bpbax - bpbdx - bpbx^2}{sax + sx^2}.$$

But by the 12. Prop. 2d Lib. *Euc.* $AB^2 = AC^2 + CB^2 + 2AC \times CG$. That is in Algebraic Terms,

$$\frac{d^2 c^2 + 2dc^2 x + c^2 x^2}{x^2} =$$

$$\frac{d^2 c^2 - d^2 x^2 + 2dc^2 x - 2dx^3 + c^2 x^2 + a^2 x^2 + 2ax^3 + b^2 x^2}{x^2} +$$

$$+ \frac{2sk^2 bx - 2sk^2 x^2 - 2bpbda - 2bpbax - 2bpbdx - 2bpbx^2}{sax + sx^2}.$$

Reduce

Reduce this, and exterminate the Quantities which destroy One another, and for k^2 restore its Value above found. Then

$$2sbd^2c^2 - 2sbd^3x^2 + 4sbd^2cx - 4sbd^3x^3 + 2sbc^2x^2 + 2sba^2x^2 + 4sba^2x^3 - 2sd^2c^2x - s^2d^2x^3 - 4sdc^2x^2 + 2sd^2x^4 - 2sc^2x^3 + sa^2x^3 - 2sax^4 + sb^2x^3 + sab^2x^2 + sa^3x^2 - 2sda^2x^3 - sa^4d^2x^2.$$

Divided by $2bpax^2 + 2pb^2dx^2 + 2pb^2dax + 2pb^2x^3$.

$$\{ = b = \sqrt{c^2 - x^2}. \text{ Or by Substitution } \frac{m + nx - qx^2 + rx^3 + sx^4}{tx + lx^2 + fx^3}$$

$= \sqrt{c^2 - x^2}$. This involv'd, and brought into Numbers, will produce the following Equation of the 8th Power $x^8 + 10.3303x^7 - 294.8875x^6 + 486515.37x^5 + 20167098.3x^4 - 270427545.014x^3 - 13736480320.5x^2 + 31359884269.94x = -2294972348845.65$ and by converging Series x will be found $= 16.05$ Leagues $= Bp$. And hence also $Cp = 29.95$; $SD = 111.726$ Leagues. $SA =$

$$131.841 \text{ L. } AE = 87.21 \text{ L. } Dp = 63.915 \text{ L. } = 3 : 12$$

$$\text{South, } Sp = 47.774 \text{ L. } = 2 : 23 \text{ N}^\circ. \text{ SB} = 50.458$$

$$\text{Leagues; The Angle DSA} = 32 : 4 \text{ being SSW } 9 : 34$$

$$\text{Westerly. The } \angle BSp = 18 : 33 \text{ being S by E } 7 : 18 \text{ Easterly.}$$

$$\text{The Angle EBP} = 36 : 37 \text{ hence the William's Course from the Equator to A is S. W. by W. } 2 : 52 \text{ Southerly.}$$



New ENIGMAS to be answered.

(1.) ENIGMA the 23^d, by W. W.

EQUAL to *Adam's* Age, our Parents they,
Do claim their Beings from this Mass of Clay,
And ever since (like unto *Adam's* Race)
As some decay'd, so others took their Place;
Thus in Process of Time we were brought forth,
A Num'rous Train, but in what Part o'th' Earth
We first appear'd; there is no certain Ground,
But in *Britannia's* Isle we now abound,
And chiefly in the Cities and Great Towns,
Our Stature's short, our Shape's most regular,
Some of us black, some brown, and others are
Of a Complexion beautiful and fair.
The Females do us kindly entertain;
And each a Favourite of theirs remain,
Until we are with them familiar grown,
And then we prove the Objects of their Scorn;
Our Female Friends (if that we may so say),
Do use us in a despicable Way;
Our Necks are all infolded with a String,
Like condemn'd Malefactors we do swing;
Nay, further, for to aggravate our Woe,
They throw us, push us, toss us too and fro;
At length worn out with Time, each charming Fair,
Doth of our Toll and Labour reap a Share.

(2.) ENIGMA the 24th, by I. H. M.

IN Ancient *SATURN's* happy Reign,
Whilst Men observ'd the Golden Mean,
In private Cells I liv'd obscure,
And most were Strangers to my Power;
But when succeeding Ages try'd
The Sweets of Luxury and Pride;
Then into publick Vogue I came,
And soon acquir'd a lasting Fame:
Where Peace and Plenty most increas'd
I in Proportion was caress'd;
Not for my Beauty or my Birth,
But for my Great internal Worth;

Bold

Bold Mortals cross the rugged Main,
My Pomp and Grandeur to maintain,
And every Quarter of the Globe,
My Treasures to enrich, they rob.
In different Shapes I oft appear,
And different Kinds of Garb I wear;
But tho' sometimes in Gold attir'd,
I'm ne'er a whit the more admir'd.
With grave Advice, and kind Intent,
I'm oft on dangerous Errands sent;
And to such Drudgery submit,
As to relate would scarce be fit:
Sometimes a tedious Day and Night,
I'm close engag'd in dubious Fight;
But hard's the Fate I undergo,
I perish with my vanquish'd Foe.
Heroes and Kings (of Mem'ry blest)
When by invading Powers oppress'd,
Have frequently implor'd my Aid,
And Rev'rence to my Orders paid,
Lands noted for Barbarity,
Retain a due Respect for me:
In fruitful *Italy* and *France*,
I have a large Inheritance:
Both *Holland* and the *British* Isle
Do me their friendly Guardian stile.
But though such Wonders I can boast,
My hopeful Projects oft are cross'd;
And maugre all my Pow'r and State,
I must obey superiour Fate.

(3.) ENIGMA the 25th, by W. W.

YE Bards of piercing Wit, who covet Fame,
By solving Matters knotty and abstruse,
Declare unto the World what is my Name,
And whence I mine Original deduce!
None can Heroick Actions undertake,
Without Concurrence of my potent Aid,
In Battle I the Soldier ne'er forsake,
Until he lifeless on the Ground be laid;
I am your faithful and familiar Friend,
Yet one Thing justly may command Surprize,
Though

Though I your Motions constantly attend,
 I never was expos'd to Humane Eyes,
 Men of deep Learning and refined Sence
 Are at a Loss my Nature to explain,
 And where I keep my stated Residence,
 A Secret is, and will perhaps remain.
 Some modern Sceptics my Existence doubt,
 Others a future State to me deny ;
 But He, that against Reason will dispute,
 Does not deserve a rational Reply.
 There's one peculiar Property I have,
 Which none of Mortal Race could ever claim ;
 Whilst they by Age, draw nearer to the Grave,
 I'm neither old nor young, but still the same.

(4.) ENIGMA the 26th, by W. E—st—b.

YOUR Charms, fair Ladies, many Captives make,
 And Numbers sigh and suffer for your Sake ;
 Petition, supplicate, and beg in vain,
 And You, obdurate You ! despise their Pain :
 Let Love and Merit languish at your Feet,
 Whilst Rakes and Fops a kind Reception meet
 No Wonder then such Wrongs I undergo,
 And for your Sake do suffer so much Woe.
 First torn from my indulgent Mother's Arms,
 I quickly faint and loose my Native Charms :
 Thus roughly us'd in tender Infancy,
 By mercenary Hands for you I die ;
 A Slave, a Captive, made by Foreign Hands,
 I'm doom'd and sentenc'd into distant Lands :
 Fearless of Danger, they all Hazards run,
 To carry me to Climates of their own.
 Where e'er I enter I support the King,
 And Mirth and Pleasure to the Ladies bring ;
 A secret Satisfaction I convey,
 And they at first a kind Respect do pay ;
 But Oh ! the fatal Change, they soon contrive
 A Doom for me, no Mortal can survive.
 First in a little Dungeon I am plac'd,
 Put on a Carr most elegantly grac'd :
 Adorn'd with Party-Colour'd Black and Gold,
 Made by mechanick Art of curious Mould ;

And

And thus by Female Cruelty confin'd,
 I to my greatest Enemy am join'd.
 With Pleasure they my Ruin undertake,
 Themselves Diversion, and their Friends to make.
 And to compleat the cruel Pomp and State,
 Divers Attendants on my Carr do wait;
 A splendid Train, all dress'd in gay Attire,
 Which Wit and Mirth, instead of Grief inspire.
 Sometimes a dozen more or less there are,
 And each a Silver Engine too does bear:
 Upon a concave Surface each does stand,
 Have each a Foot, but neither Ear nor Hand;
 Each has a Mouth, by which they catch my Blood,
 When shed by You, fair Ladies! in a Flood;
 Who pitiless, and with insulting Pride,
 Laugh at my Woe, and all my Wrongs deride.

(5.) ENIGMA the 27th, by W. W.

WHEN *Adam* and his lovely Consort *Eve*
 Their wonderful Existence did receive,
 I was appointed with them to reside,
 A friendly Counsellor, and faithful Guide:
 When they from Paradise were justly driv'n,
 And forfeited th' indulgent Smiles of Heav'n,
 I kindly help'd to sooth their destin'd Cares,
 And stem the Torrent of their dismal Fears.
 When Righteous *Noah* by Divine Command,
 Had built an Ark the Deluge to withstand:
 With him I enter'd; there I dwelt secure,
 From threat'ning Waves, which did the World devour.
 When Earth appear'd again with Verdant Face,
 And Men had largely multiply'd their Race,
 I was transferr'd with them from Place to Place.
 By their capricious Humours strangely tofs'd,
 Until my lovely Charms were almost lost.
 And now to such Immensity I'm grown,
 That, *Hydra* like, I have more Heads than one:
 Yet though in this Respect I monstrous seem,
 Thousands for me profess an high Esteem;
 Blindly promote my arbitrary Sway,
 And to my strictest Rules Observance pay.
 Where I retain my simple Native Charms,
 I gain Dominion without Force of Arms;

For

For all my Laws, when rightly understood,
 Are calculated for the Publick Good ;
 Yet I have num'rous, strong, malicious Foes ;
 Whole Kingdoms oft my kind Designs oppose,
 Pursue my Followers with destructive War,
 And from all earthly Joys would them debar:
 But if the various Tortures could be shown,
 Which mine Adherents oft have undergone
 For Loyalty, unto their Sovereign Head,
 'Twould strike the most Heroick Soul with Dread.
 But least inserting this disclose my Name,
 • The Priviledge of Secrecy I claim.

(6.) *ÆNIGMA the 28th, by I. H. M.*

BY Genial Heat I in the Womb was bred,
 And with prolifick Juices daily fed,
 'Till in due Season I disclos'd my Head,
 In Dangers great my Infant Days I pass'd,
 Expos'd to Death by every sudden Blast
 Adorn'd with Emblematick Innocence,
 A slender Covering was my chief Defence ;
 But as I gain'd a firmer Strength of Nature,
 I by Degrees increas'd in Bulk and Stature.
 When all my Parts were to Perfection come,
 I in few Days forsook my Native Home ;
 To some adjacent City did resort,
 Where Male and Female did my Favour court ;
 Arrayed in a shining Scarlet Gown,
 I in Procession rode about the Town,
 An Officer with artful Tone set forth
 My comely Features and internal Worth ;
 My swelling Cheeks like *Bacchus* on his Tun,
 Would e'en perswade you that I was his Son.
 My rich Appearance prov'd a tempting Bait,
 And Multitudes, to seize my Store, laid wait :
 For Lucre Sake I quickly was betray'd,
 And to my greedy Foes a Prey was made ;
 I perish'd, but mine Heart remain'd compleat,
 Lodg'd in a curious Stony Cabinet ;
 Which either was reserv'd for Propagation,
 Or else apply'd to Puerile Recreation.
 Unlike my Parent, I'm in Shape and Hue,
 Yet dare avouch myself her Offspring true.

New

New Mathematical QUESTIONS to be answer'd.

(1.) QUESTION the 57th, by W. W.

A Father dying to his Son thus said,
The other Day my Testament I made,
By the Assistance of an Artist's Skill,
And this in Part's the Tenour of my Will.
To you I have bequeath'd when you arrive
At such an * Age, One Hundred Pounds and Five : * *Unknown*
Now if that † Number which I will not name, † *Viz. The*
Be added to the Square Root of the same, *Number of the*
And then those Numbers squar'd, and you do take *Years of his*
The Cube Root of this last : The Sum will make *Age.*
|| Just the same Number you i'th' Margin find. || 9659
You who are skill'd herein, pray be so kind
As tell when I my Portion may demand,
For I the Will in no wise understand ;
But must I fear in doubtful Case remain,
Unless to me the Matter you explain.

(2.) QUESTION the 58th, by R. G.

Three Persons have amongst them 110. Crowns : The first gives half of his in equal Shares to the other two : The second gives one third of the Crowns he then had to the other two : And the third Man gives 10. Crowns to each of the other ; and then they found that every Man had an equal Number. Required what Number of Crowns each had at first.

(3.) QUESTION the 59th, by J. T.

Among the ancient Monuments of the Eastern World ; Travellers have taken Notice of a Pillar of Stone in * *Palestine* ; the same (according to Tradition) which *Absalom* rear'd for himself in his Life time : " We arrived here, says a certain Author, upon the Fourth of " *July*, at Three a Clock after Noon, and observed that " the Length of the Shadow from the Foot or Outside of " the Pillar (which is in the Form of a Sugar Loaf) was
F then

d i
* In the Parallel of 30 : 40 North.

42 *New Mathematical Questions to be answered.*

then thirty five Feet ;” and supposing its Solidity 65000. Feet, hence the Height thereof, and the Diameter of its Base, may be found and are required.

(4.) QUESTION the 60th, by J. N.

TWO Ports i'th' Latitude of * Forty Seven, * 47:0 N°. There lye, whose Distance in the Margin's given: || 96 L In each of these two Ports a Ship is found, Who by Design unto one Port are bound. Whose Latitude I here to you define, Just Forty Eight Degrees, and Minutes Nine ; Twixt North and East, the Westermost did steer, But betwixt North and West it did appear, The Eastermost her Course indeed confin'd, Being the nearest to the Port design'd, Their Rhumb-Lines making at the Port where met

This Angle which is in the * Margin set. * 110:— Now each Ship's Course and Distance pray descry, And it construct Geometrically.

(5.) QUESTION the 61st, by E. H-x-l-y.

THREE Ships (suppose the *Suffolk*, *Kent*, and *Albemarle*) sail from a Port in the Latitude of 50 Degrees North, and Longitude 24 Degrees West, on the North Part of the Shore of a circular Lake, whose Diameter is unknown : The *Suffolk* sails between the South and East 10 Leagues, the *Albemarle* between the South and West 20 Leagues ; each to a Port on the ambient Shore. The *Kent* also sails from the first Port a certain Course between the South and West 12 Leagues, until she became equidistant from the other two Ships in a streight Line : It is required to find each Ship's Course, Distance sailed, Difference of Latitude made, with the Longitude and Latitude they are now in, and the Diameter of the Lake.

(6.) QUESTION the 62d, by J. T.

TWO Ships sail from a certain Port in North Latitude, one steers between the South and East 40. Miles : The other between the South and West 96 Miles. Now if

if the Westermost Ship's Difference of Latitude be 36 Miles more than that of the Eastermost; and the Eastermost Ship's Difference of Latitude be a mean proportional between their Departures; it is required to find each Ship's Course, Departure, and Difference of Latitude.

(7.) QUESTION *the 63d, by J. T.*

A Brewer of Note in the Town lately sent
For his Cooper, and told him it was his Intent,
That he should make for him a Conical Tub :
Being minded withall for to give him a Rub.
Quoth he, Yesterday as I happen'd to be
At my Neighbour's, a Tub I chanced to see,
And o' th' same Size and Form you must make one for me. }
The Width at the Top is — On Paper I wrote it,
But being in haste, in good Truth I've forgot it';
Yet thus much remember, That a Hoop just so wide
As the said Diameter is, did the Tub circumscribe,
When upright 'twas plac'd, and fixt very tight
With the four Ends of the Diameters right ;
Besides the Height of it I found just to be
Equal to the lesser Diameter exactly :
And it held, my Friend told me, neither less nor more
Than Ale-Gallons Two Thousand One Hundred and Four.
The Cooper this hearing to Work straightway went,
But could'nt make the Dimensions fit to the Content :
So your Help at this Juncture be pleased to lend,
And you'll much oblige your Servant and Friend.

(8.) QUESTION *the 64th, by L. N.*

LET a Spheroid Cask, (whose Heads Diameter being the *Latus Rectum*, is in Proportion to the Bungs as 5 is to 8.) contain One Hundred and Thirty Gallons of Ale; then supposing a Cone whose Base's Diameter is 8 Feet, and its Altitude 14. to be so cut, as that the Plain of the Section by its Rotation, about its Axis, should generate the Spheroid, whereof this Cask is the Middle Zone. The Distance from the *Vertex* where that Plain cuts the Axis, its Inclination thereto, and the Dimensions of the Cask are required.

(9.) QUEST-

44. *New Mathematical Questions to be answered.*

(9.) QUESTION *the 65th, by E. H-x-l-y.*

Admit there be a Field in Form of a Trapezia, two of its Sides being each in Length 36. Chains : The One being the Sine of an Arch of a Circle, the other the Chord of the Complement of that Arch ; and one of the unknown Sides, being the Co-sine of the first Arch, and the other unknown Side the Radius of the Circle. Required the Length of each of the unknown Sides, and the Area of the Trapezia.

(10.) QUESTION *the 66th, by W. W.*

IN *Derwent* Ings there lies a Piece of Ground, Its Form a right-angled Triangle found : Which once I was requested to survey, But met with Difficulties in the Way ; The River, swell'd by long continu'd Rains, Had almost overflown the neighb'ring Plains : I just could come at the right Angle's Place, And likewise at a small Part of the Base ; In the Hypothenuse a Tree there stood, Whose lott'y Branches triumph'd o'er the Flood ; At which, from the Right-Angle, Observation I took, and found, that if unto my Station A Line was drawn directly from the Tree, The certain Consequence thereof would be, That the Right-Angle would precisely seem Cut into mean Proportion and Extream ; The Mean it lying (if I right define) Betwixt the Base and the Bisecting Line. From the Right-Angle then with nimble Speed, I did in measuring the Base proceed ; Soon as I found the Mensuration Sum Did to Nine Chains and Forty Nine Links come, I halted, then observ'd the Tree again, And found, that if a Line from it was drawn, To this, which I my Second Station call, It perpendicular to the Base would fall : The Owner also gave me an Account, The Difference did to Fourteen Chains amount, Betwixt th' Hypothenuse (as had been try'd) And th' Perpendicular or shortest Side.

From

New Mathematical Questions to be answered. 45

From the abovesaid Data I'm confin'd
The several Sides demonstrably to find ;
And therefore honest Brethren of the Quill,
Pray lend the Help of your superiour Skill.

(II.) QUESTION the 67th, by J. T-ph-m.

THERE is given the Radius of the Circle $ASQ = 1$.
(Vid. Fig. 15.) and therein are Three Circles of equal
Diameters inscribed touching each other, and the greater
Circle : Required the Diameters of the less Circles, and
the Area of the little Spherical Triangle HMN made by
those Circles about the Centre.

(12.) QUESTION the 68th, by I. T.

TWO Towers let's suppose whose Height in Feet
Are Seventy Four, and Ninety Nine compleat :
Their Distance likewise measur'd on the Ground,
One Hundred Fifty Feet exact is found. ———
If now two Ladders Foot and Foot to each
Were set, and just to th' Top o' th' Towers should reach ;
That Point i' th' Distance Line I fain would know,
And beg that you the same to me will show,
When the two Ladders Lengths join'd in one Sum
Are equal to ——— a *Minimum*.

(13.) QUESTION the 69th, by R. F.

SUPPOSE AD (in Fig. 16.) to be perpendicular to the
Plain of the Horizon, and DE parallel thereto : $AD =$
43 Yards, $DE = 47$ Yards. Then upon the Point E with
the Radius $EC = 28$ Yards let a Circle be describ-
ed : It is required to find the Inclination of that Plain
as AC , on which a heavy Body will descend in the short-
est Time possible from A to (some Point in) the Circle
 $CcSQ$.

(14.) QUESTION the 70th, by R. D.

YE learn'd Adeptists (*Euclid's* Sons) by whom
True Alchymistry is *de facto* us'd ;
Not Metals, but Equations, ye transmute
By Grand Elixir (Analytic Art.)
Vouchsafe th' subjoin'd * Equations to evolve.

$$\left. \begin{array}{l} * x^y = a = 5000. \\ y^* = b = 3000. \end{array} \right\} \text{—————}$$

46 A Question in the Ladies Diary 1726, Answered.

THE Editor of this *Miscellany* having proposed a Question in the *Lady's Diary*, 1726, Page the 16th, about finding the Area of an Ellipsis, &c. from three Lines given in Magnitude and Position, intersecting each other in one of the *Foci*: And it being said, in Page the 7th of the *Ladies Diary*, 1727, that the said Question is unlimited; he thinks himself obliged to clear it from that Imputation, and hopes it will not be unprofitable to the Reader, as it is not foreign from his Subject. My Method of Solution is as under. In *Figure the 17th*, Let AEFPD be the Ellipsis, S the given *Focus*, H the other *Focus* sought; SE = 200. Feet, SF = 313.62, SD = 872.62; the Angle ESF = 25 Degrees, the Angle FSD = 65 Degrees. Join the given Points by drawing the Lines DE, DF, EF, which will also be given (because in each of the Triangles 2 Sides and a contained Angle are known) from H draw the Lines HD, HE, HF, and put z = transverse Diameter of the Ellipsis AP, SE = b ; SF = c ; SD = d ; Then is HD = $z - d$; HE = $z - b$; HF = $z - c$; as is plain from the Nature of an Ellipsis: That is, the Problem amounts to this, to find a Point H, from whence the Lines HE, HF, HD being drawn, they shall have given Differences: Which Problem you may find proposed by me, Question the 167th in the *Ladies Diary* 1732, and analytically solved by me, &c. at Pages the 9th and 10th *Lad. Diary* 1733; by a Quadratic Equation. According to which Method, the Lines HE, HF, HD will come out = 800.; 686.38; and 127.38 and the Length of the Transverse Axis = 1000. The Method of Operation here will be the same as there; only in the present Case the Point H falls without the given Triangle EFD, and in the Question proposed in the *Diary* it falls within. And now HF, HD, being found, and DF before known = 793.0

we shall find the Angle HFD to be equal $5 : 23$ and adding it to the Angle SFD = $93 : 59$ gives the Angle

SFH = $99 : 22$; again SF, FH and the contained Angle being known, we may find SH the Distance of the *Foci* to be 800. Feet, and consequently the Semi-Conjugate Axis of the Ellipsis BK is = 300. Feet, and the Conjugate 600. Lastly,

A Question in the Ladies Diary 1726, Answered. 47

Lastly, for the } Put $\begin{cases} AK = n = 500. & Km = p, = 200. \\ \text{Length of the } & BK = m = 300. & Kp = x, \end{cases}$
Ditch qr , Then is

$Ap = n - x$; and $Pp = n - x$; and $mp = x - p$.

By the Property of the Ellipsis As $\overline{AK}^2 (n^2) : \overline{BK}^2 (m^2)$

$$:: \overline{Ap} \times \overline{Pp} (n^2 - x^2) : \overline{pr}^2 \left(\frac{m^2 n^2 - m^2 x^2}{n^2} \right) \quad \text{But}$$

$\sqrt{mp^2} + \overline{pr}^2 = mt$. which by the Question must be a

Minimum. Ergo
$$\frac{\sqrt{n^2 x^2 - 2n^2 p x + n^2 p^2 + m^2 n^2 - m^2 x^2}}{n^2} =$$

in Fluxions to nothing. $n^2 x x - n^2 p x - m^2 x x = 0$;

and by Transposition and Division $x = \frac{n^2 p}{n^2 - m^2} = 312.5$

therefore $mp = 112.5$ Feet, and $mt = 259.8$; and the Angle of Inclination $p m r = 64^\circ : 21'$ its Nat. Sine $= .90145 = h$; its Cosine $= .43287 = g$; and finally putting $Kr = x$, mr will be $= p - x$; and the other

Symbols remaining as before $qr^2 = \frac{m^2 n^2 - m^2 x^2}{n^2}$

But As $g : p - x :: h : \frac{bp - bx}{g} = qr$. & $\frac{b^2 p^2 - 2b^2 p x + b^2 x^2}{g^2}$
 $= qr^2$. hence $\frac{m^2 n^2 - m^2 x^2}{n^2} = \frac{b^2 p^2 - 2b^2 p x + b^2 x^2}{g^2}$

And by Reduction and Transposition we shall have

$$m^2 g^2 x^2 - 2b^2 n^2 p x = + m^2 n^2 g^2 \quad \text{In Numbers } x^2 -$$

$$369.4x = -17769. \quad \text{And } x = 184.7 = \sqrt{16349.09} = +127.8; \text{ here } x = 56.9 \text{ and } mr = 143.1 \text{ And } mn = 330.66;$$

Wherefore the whole Length of the Ditch is 590.46 Feet.

N. B. I also had design'd to have given in this Place a Solution to the Exponential Question proposed by Mr. R. Fearnside, in Page the 1st, *Ladies Diary*, 1732, among the Latin Enigmas, and which has not yet been answered in the succeeding *Diaries*, viz. $x^x - x = y$; and $y^y + y = x$; to find the Values of x and y . But for want of Room am obliged to omit it. Only I shall observe that $x = 1.7481$ and $y = .9058$.

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Kingston-upon-Hull,

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 pleas'd with the happy Situation whilst hunting with his No-
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 with what remarkable Acci-
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 them in the Course of their
 LIVES: Interspers'd with a
Chronological British History,
 especially what alludes to the
Civil Wars, for the better Illus-
 tration of those Things which
 most particularly concern'd the
 Town in those troublesome
 Times; and since then, in re-
 lation to the Revolution.

[Adorned with Cuts.]

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 (Towns situated on the Sea Shore) for the Entertainment of the
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Di probos mores docili juventæ,

Di senectuti placidæ quietem,

Oppido HULLINO date, remque prolem-
 que et decus omne.

HOR. Car. Sæc.

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Fig. 17

